



CASE STUDY

Consequences of changing regional integration on environmental development, agricultural markets, and food security

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ABSTRACT

BACKGROUND AND OBJECTIVES: Geopolitical risks have made significant changes in the integration ties between the countries of Central Asia, which has affected the sustainable development of the agro-industrial complex and food security. The adoption of urgent measures to improve food security, on the one hand, is a necessary condition for the development of the Republic of Kazakhstan, but on the other hand, it can lead to a decrease in the level of environmental security in the country if the possible consequences in the reintegration process are not considered. Therefore, this article aimed to examine the sustainable agriculture practices implemented in Kazakhstan's agro-industrial complex to improve food security and reduce the environmental impact of agriculture.

METHODS: To collect information, a mixed research strategy combining qualitative and quantitative methods was used. The collection of information was carried out in the summer of 2022 and consisted of three stages. In the first stage, statistical information was collected; in the second stage, a correlation analysis was carried out; and in the third stage, a survey of 40 experts was conducted.

FINDINGS: The data obtained indicate that the efficiency of Kazakhstan's agricultural production strongly and directly depends on the level of the country's integration into the united Eurasian Economic Union market. Due to the geographical features of Kazakhstan's location, it is necessary to develop areas that are primarily focused on the internal capabilities of the country. Internal changes will help the industry increase international competitiveness and efficiency while promoting sustainable development and ensuring food security and environmental safety.

CONCLUSION: The article determined that it is necessary to prioritize developing multilateral partnerships to address transportation and logistics challenges in the export and import of agricultural products, and reduce dependence on the import of seeds, breeding products, fodder, and agricultural machinery. However, to effectively promote these areas, it is necessary to improve food security through the introduction of sustainable agriculture practices, such as crop diversification, conservation agriculture, integrated pest management, and drip irrigation.

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INTRODUCTION

Global upheavals related to the persistence of crises in the global financial and economic system, the coronavirus disease 2019 (COVID-19) pandemic, military conflicts, and sanctions have shown the vulnerability of many agricultural and food systems and exacerbated the decline of food security in the world (Kryshyanovich et al., 2022). It can be argued that representatives of particularly developed countries of the world are actively predicting a humanitarian catastrophe that must be averted (WFP and FAO, 2022). The Eurasian continent, particularly its central region, is currently experiencing a state of reintegration. Due to their geographical location, countries need to look for ways to improve food security by intensively developing the agro-industrial complex while avoiding damaging environmental safety in the region (Beilin et al., 2019). The Eurasian Economic Union (EAEU) is the integration association that includes five member countries of the post-Soviet space (Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia) and has significant potential to become a powerful subject of the Eurasian continent (Ametoglo et al., 2018). One of the main objectives of the EAEU is to support the principles of sustainable development, which are based on three main principles: economic, social, and environmental sustainability (Liu et al., 2023). Considering the focus of the article, the main attention is drawn to the topic of environmental sustainability. Environmental sustainability aims to develop uniform environmental standards, encourage the use of renewable energy, improve energy efficiency, and develop sustainable agriculture (Alekseenkova et al., 2017). The development of sustainable agriculture helps ensure food security (Li et al., 2021), conserve biodiversity, and reduce the impact of agriculture on the environment (Khoruzhy et al., 2022). These initiatives can be implemented through regional integration, trade, socially responsible development, environmental protection, and cooperation in various fields. Therefore, the consequences of the aggravation of international conflicts and economic restrictions that occurred in 2022 started to affect the integration ties between partner countries (Bezpalov et al., 2023). Practical interactions between EAEU countries and neighboring territories are seeking new ways to function in the current environment (Makhmutova et al., 2019). The agricultural sector is seeing a reorientation of

participants, causing a redistribution of cash flows toward new food markets and marketing channels for agricultural products and fertilizers (Ng'andu et al., 2021). This disruption may negatively impact not only Kazakhstan's sustainable development, but also EAEU countries in general (Marrella et al., 2021). One of the main reasons for such changes is the reduction in investment from Russian businesses in Kazakhstan's agricultural sector, as well as a decline in access to Russian technology and equipment (Suslov et al., 2018). This has hindered the growth and modernization of Kazakhstan's agricultural sector, which is crucial for ensuring food security in the country (Leka et al., 2022). The most acute argument that can be highlighted in the sphere of the provision of agricultural food is the attitude toward the discriminatory decision of the Russian Federation in the EAEU on the temporary ban on the export of grain (wheat, corn, rye, and barley) to the EAEU (DGRF, 2022). Preliminary data suggest that the decision had a negative impact on business in Kazakhstan (Tsirkulik, 2022). The country's leadership claims that it is because of these actions, in particular, that up to 70 percent (%) of the mills in Kazakhstan have been forced to stop or continue operating without a reserve (Kalinkina, 2022). Another instance of a conflict situation, the closure of the transport corridor for Kazakhstan's imports of foreign equipment, seeds, and spare parts through Russia, may severely impair the agricultural industry of Kazakhstan (Sarabekov, 2022). The situation in which EAEU countries find themselves due to the introduction of ten packages of sanctions against Russia and Belarus by the United States, the EU, and the United Kingdom in response to the special military operation in Ukraine can be described as complex, jeopardizing the existence of the EAEU in its former form, which cannot affect the development of the agricultural products market (Wang et al., 2021). Yet, from another perspective, the consequences of the armed conflict in Ukraine (Sutyryn et al., 2018) give reason to conclude that for EAEU member states, the partnership can be very promising (Zavoronok et al., 2022). The escalation of the conflict has exacerbated trade, production, price, and logistics risks. According to preliminary estimates by the Food and Agriculture Organization (FAO), the conflict will result in 20–30% of the areas under winter grains, corn, and sunflowers in Ukraine either not being planted or remaining unharvested

during the 2022/23 season (FAO, 2022). This state of affairs encourages the enhancement of cooperation within the EAEU regional integration framework, as well as with other countries, which will allow loading production facilities, creating additional jobs, and expanding the geography of exports of agricultural products to many countries of the world (Pyzhikov, 2022). EAEU member states have additional opportunities to advance their own agricultural production, which will not only strengthen their food security, but will also increase the export potential of the agro-industrial complex (Nechaev et al., 2021). For example, the reduction in exports from Ukraine and Russia provides an opportunity for Kazakhstan to strengthen its agricultural export market and revise its markets by establishing new regional integration. Regional integration systems are a relatively new subject of research, although they have been contributing to geo-economic development for many years. Regional integration is a multidimensional process that can take the form of coordination, cooperation, convergence, and deep integration initiatives and extends not only to economic and trade issues but also to political, social, cultural, and environmental aspects (Lavery and Schmid, 2021). The purpose of this study is to study the development of Kazakhstan's agro-industrial complex by implementing sustainable agriculture practices to improve food security while reducing the impact of agriculture on environmental safety. This study was performed in the Almaty region of Kazakhstan in 2022.

MATERIALS AND METHODS

This was a joint study between Turan University, Narxoz University, Al-Farabi Kazakh National University, Kazakh Research Institute of Economy of Agro-Industrial Complex and Rural Development, Almaty Academy of Economics and Statistics, and the University of International Business. The researchers working in the universities collaborated to design and conduct the study. Involvement in the data collection and analysis process allowed them to apply a consistent mixed-method approach that incorporated both qualitative and quantitative methods. The study included a sectoral analysis of the development of the market of agricultural products of the EAEU, a correlation analysis of the influence of specific factors on the gross regional product of

agriculture of Kazakhstan, and an expert evaluation of motivational factors and barriers to the development of production, which informed policies related to agricultural development and investment. The researchers' expertise in the fields of agriculture and economics played a critical role in the success of the study. Their in-depth knowledge of the subject matter and the statistical tools used in the analysis helped ensure the accuracy and reliability of the results. The researchers' ability to work collaboratively and share their knowledge and skills was instrumental in developing a robust and comprehensive analysis of the agricultural market in the EAEU.

This study has been conducted in three stages:

Stage 1 was prepared an information database of statistical data that included official sources of statistics. The statistical information used in the survey was obtained from a variety of official sources of statistics, such as the FAOSTAT, UN Comtrade, WTO, IFOAM, the Ministry of National Economy of the Republic of Kazakhstan, the Ministry of Agriculture of the Republic of Kazakhstan, and the Ministry of Trade and Integration of the Republic of Kazakhstan. These data were used in the correlation analysis to assess the impact of integration factors on the development of Kazakhstan's national agricultural market within the EAEU.

Stage 2 involved a correlation analysis. To assess the impact of integration factors on the development of the national agricultural market of Kazakhstan within the EAEU, a correlation analysis was carried out using the "data analysis" tool in the Excel environment. In studying the impact of integration factors on the development of Kazakhstan's national agricultural market within the EAEU, it is important to consider both dependent and independent variables. The dependent variable was the value of the gross value added (GVA) of agriculture as one of the most important factors characterizing the economic efficiency of the industry. In the context of regional integration, it is particularly relevant to assess the GVA of agriculture in each country of the regional organization. This allows for a comparison of the relative importance of agriculture in the economies of different countries, and can inform policies related to agricultural development and investment. Additionally, it can help identify countries with the potential for growth in their agricultural sectors, as well as countries that may require additional

support to strengthen their agricultural industries. As the dependent variable in the analysis, the GVA of agriculture measures the economic output generated by the agricultural industry in Kazakhstan. It is an important indicator of an industry’s overall economic efficiency and productivity. The independent variables in the analysis are the integration factors that characterize the level of integration of the country into the common agricultural market of the EAEU (Table 1).

Kazakhstan’s exports to EAEU countries, as well as its exports outside EAEU countries, contribute to the overall economic growth of the country. According to the World Bank, agriculture is a key sector in Kazakhstan’s economic development. Kazakhstan’s share in agricultural production in the EAEU, along with its share of the volume of investment in the agricultural sector of the EAEU countries, indicates the country’s position and importance in the regional agricultural sector. As a member of the EAEU, Kazakhstan benefits from various trade agreements and partnerships that enable it to boost its agricultural production and exports. The agricultural price index is an important parameter that reflects the overall performance of the agricultural sector. According to the FAO, the agricultural price index is an indicator of changes in international prices. A high agricultural price index is beneficial for the agricultural sector as it indicates higher prices for agricultural products and higher revenue for farmers. Understanding the impact of dependent and independent variables on the development of the national agricultural market

of Kazakhstan within the EAEU is critical for making informed decisions regarding the development of the sustainable agricultural sector in the region.

Stage 3 included the administration of an expert survey. At this stage, based on the purposive sampling method (Jinji *et al.*, 2022), a group of 40 experts was formed. A detailed questionnaire consisting of semi-formalized questions was developed for feedback. The respondents included in the sample and registered in the web panels were sent invitations to participate in the online survey. The survey was administered online using WRI Survey Monkey subscription services. Responses were received from 34 experts out of the sample, including 27 agricultural producers operating in Kazakhstan and two importers and five exporters of agricultural products. To obtain quantitative information from the questionnaire, the method of scaled assessment was applied. Thus, some of the questions in the questionnaire involved an assessment on a five-point scale. The use of a five-point scale is a common method for gathering quantitative data in agricultural market research surveys (Dutbayev *et al.*, 2023). This type of scale provides a standardized way of measuring the opinions of survey participants, making it easier to analyze and compare responses. The use of a scale also helps to reduce response bias, as participants are forced to make decisions based on a predefined set of options. It allows researchers to obtain a more precise measurement of the importance of various factors related to the development of the agricultural industry. In this survey, experts were asked to assess

Table 1: Description of independent variables and sources of information

Independent variables of the model	Interpretation	Information base
Kazakhstan’s exports to EAEU countries, million United States Dollars (USD mln.)	Characterizes the export potential of the country in trade with EAEU countries	EEUF (2022)
Kazakhstan’s exports outside EAEU countries (USD mln.)	Characterizes the total value of goods exported by Kazakhstan to countries outside the EAEU	
Kazakhstan’s share in agricultural production in the EAEU (%)	Allows considering the country’s contribution to the production of agricultural products in the EAEU market	
Kazakhstan’s share in the volume of investment in the agricultural sector of the EAEU countries (%)	Allows considering the country’s investment contribution to the development of agriculture within the EAEU	
Agricultural price index	Allows monitoring changes in sales prices of major agricultural products through all sales channels	

the importance of various factors using a scale where:

- 1 – Very low importance of the factor
- 2 – Rather low importance of the factor
- 3 – Moderate importance of the factor
- 4 – Rather high importance of the factor
- 5 – Very high importance of the factor

The data obtained in the form of cross-tables were exported to Excel. After processing the responses, the possible solutions were ranked based on their importance. The data obtained were then summarized in tables of the main factors and barriers for the development of the agro-industrial complex for the opportunities to increase food security and reduce risks.

RESULTS AND DISCUSSION

Analysis of the development of the agricultural market of the EAEU

The growth of agricultural production in Kazakhstan is significant not only for the country itself, but also for its potential vendors. Kazakhstan's main trading partners in the agricultural sector are countries such as Russia, Belarus, Uzbekistan, and Kyrgyzstan. Over the past five years, the volume of agricultural production in Kazakhstan has increased by 38%,

exceeding the same figures of the EAEU member states. At the same time, Kazakhstan's share in total production increased from 11% to 12.8% (Fig. 1).

Over the five-year period, Kazakhstan has shown the highest growth rate among the EAEU countries in the number of cattle (+21%), sheep and goats (+13.79%), and poultry (+17.4%). Herewith, Kazakhstan's share of the total number of EAEU livestock increased from 21.4% to 25.3% for cattle, from 37% to 42.6% for sheep and goats, and from 5.7% to 7% for poultry. The volume of agricultural production in Kazakhstan in monetary terms increased in the considered period from 12,553 million USD in 2017 to 17,318 million USD in 2021. Kazakhstan shows the greatest growth rate of agricultural production among the EAEU countries, being well above the average for the integration union (Table 2).

Kazakhstan has significantly increasing its contribution to the volume of foreign trade in food products and agricultural raw materials among EAEU member states. Kazakhstan has more than doubled its production of livestock and poultry for slaughter in five years, raising its share of the EAEU total from 7.9% to 10.7%. Milk production increased by 12.6%, with Kazakhstan's share in total Eurasian milk production going up from 12.1% to 12.7%. During the period under review, there was an increase in the gross yield

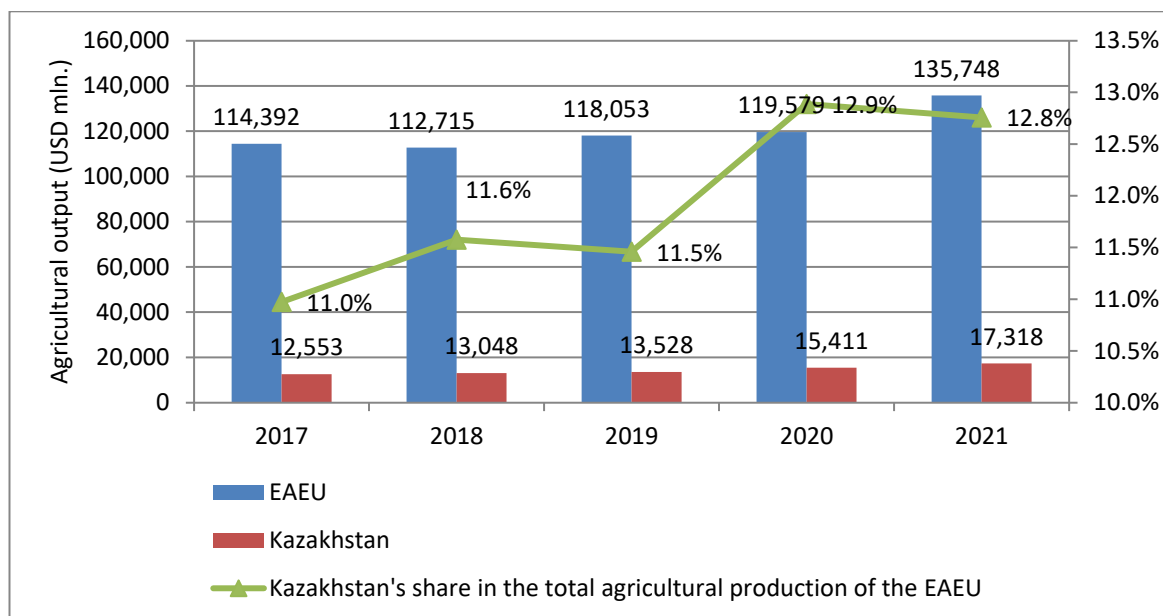


Fig. 1: Dynamics of agricultural production in the EAEU and Kazakhstan, USD million

Table 2: The volume of agricultural production in 2017–2021, USD million (EEUF, 2022)

EAEU countries	2017	2018	2019	2020	2021	Change between 2021 and 2017	
						USD mln.	%
EAEU	114,392	112,715	118,053	119,579	135,748	21,356	18.67%
Armenia	1,882	1,928	1,853	1,774	1,940	58	3.07%
Belarus	9,333	9,236	9,881	9,248	9,843	510	5.47%
Kazakhstan	12,553	13,048	13,528	15,411	17,318	4,765	37.96%
Kyrgyzstan	3,028	2,977	3,166	3,226	3,832	804	26.55%
Russia	87,596	85,526	89,625	89,920	102,815	15,219	17.37%

Table 3: Gross harvest volumes and Kazakhstan's share in the total production of the EAEU

Crop produce group	Gross harvest, thousand tons		Change in gross harvest over five years		Share in total gross output of the EAEU (%)	
	2017	2021	Thousands of tons (ths. tn)		2017	2021
				%		
Cereals	20,585	16,376.0	-4,209.0	-20.4%	12.4%	11.2%
Sunflower seed	903	1,032.0	129.0	14.3%	7.9%	6.2%
Sugar beet	463	332.0	-131.0	-28.3%	0.8%	0.7%
Potatoes	3,551	4,032.0	481.0	13.5%	10.6%	14.0%
Vegetables	3,791	4,768	977.0	25.8%	17.8%	22.0%
Fruits and berries	255	356	101.0	39.6%	6.40%	6.40%

in the physical terms of most types of crop products in Kazakhstan: sunflower seeds, potatoes, vegetables, fruits, and berries (Table 3).

The lower production of various agricultural products in Table 3, despite the overall increase in the volume of agricultural production in Kazakhstan between 2017–2021 (Table 1), can be attributed to the negative dynamics of the gross harvest rates. However, certain sectors, such as milk production and production of livestock and poultry for production of more resistant crops, had a positive impact and helped contribute to the overall growth in the volume of agricultural production, as shown in Table 1. Kazakhstan occupies a leading position among EAEU countries in terms of growth rates in the production of cereals, sunflower seeds, vegetables, fruits, and berries. Meanwhile, the negative dynamics of the rates of the gross harvest of sugar beet, cereals, and leguminous crops in Kazakhstan should be noted: a decrease of 28.3% and 20.4%, respectively. Among the main reasons for the decline in grain production in Kazakhstan are low yields due to difficult agro-climatic conditions (Fig. 2).

Over the five years, a decrease in the yield of grain and leguminous crops was observed in all EAEU countries.

The most significant drops occurred in Armenia (from 20 to 12.9 quintals per hectare [q/ha] [-35.5%]), in Kyrgyzstan (from 30 to 22.5 q/ha [-25%]), and in Kazakhstan (from 13 to 10.4 q/ha). In the mutual trade of EAEU countries, agricultural products and food products account for more than 18% of the commodity structure, while in trade with foreign partners, their share amounts to 10%. Overall, EAEU countries demonstrate significant growth rates in agricultural exports to third parties. In five years, this figure increased by 73.4%, exceeding the same indicator of such a large integration association as the EU. In particular, exports of meat and edible meat byproducts from the EAEU increased 4.8 times, exports of dairy products and eggs rose 2.5 times, exports of fats and oils of animal and vegetable origin became 2.5 times higher, exports of cereals grew 1.5 times, etc. Comparatively, according to Eurostat, the growth rate for exports of meat and meat offal of such a large world integration association as the EU was only 11%, 12.6% for exports of dairy products and eggs, and 19.8% for fats and oils (Eurostat, 2022). The volume of foreign trade turnover of agricultural products and food products in Kazakhstan in value terms increased by 33.4%, while the volume of mutual trade between Kazakhstan and other EAEU countries increased by 37.9%. The export

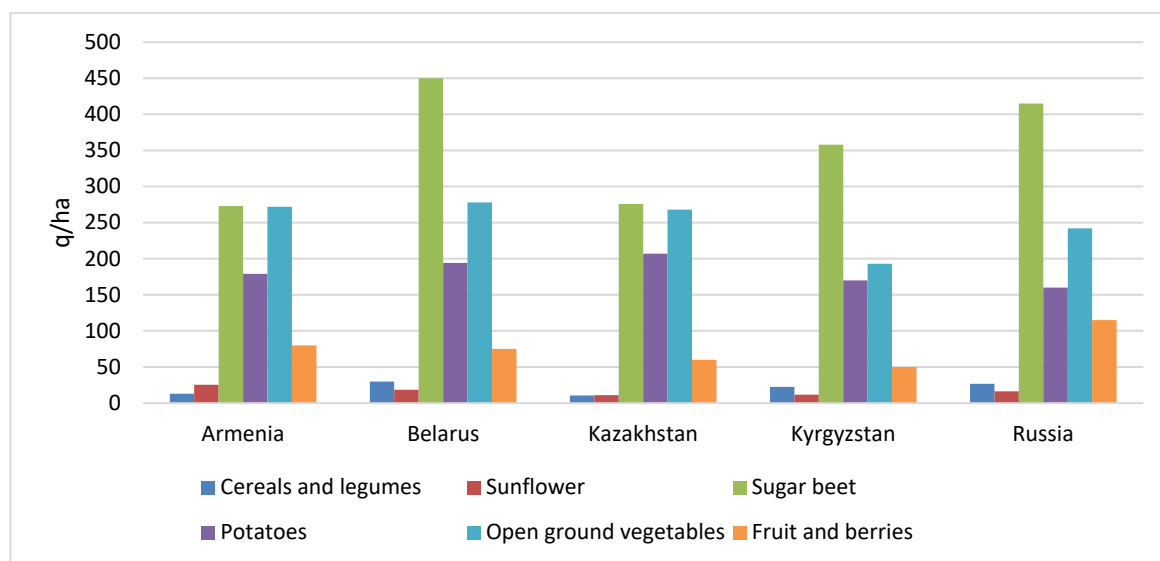


Fig. 2: Agricultural crop yields in the EAEU countries in 2021, q/ha

of agricultural raw materials and food products from Kazakhstan to the foreign market in value terms rose by 1,119.5 million USD (+58.2%). The growth in exports has led to an increase in the income of domestic agricultural producers and has created new opportunities for investment, as well as influenced the development of state programs to support the agricultural industry (SPDAICRK, 2018). The increase in exports has also led to the development of new infrastructure, such as transportation networks (Polukhina, 2021), storage facilities (SPDAICRK, 2018), and processing plants (OIRPMRK, 2019), which have improved the efficiency and competitiveness of the sector. At the same time, Kazakhstan's share in the total volume of exports of agricultural products of EAEU countries decreased from 9.4% to 8.5%. The most export-oriented goods in Kazakhstan are cereals (wheat and barley), sunflower seeds, sunflower oil, cheeses, grapes, berries, stone fruits, and pasta. Although the increase in Kazakhstan's average agricultural prices for wheat is more modest compared to other EAEU countries (+15.6%), it has reached 223.7 thousand USD per ton, which is 40% higher than Belarusian prices and 15.4% higher than Russian prices. Compared to other EAEU countries, the most competitive productions of Kazakhstan in terms of prices are the production of vegetables (onions, cabbage, and carrots), eggs, and pork in live weight (EAEU, 2022). EAEU countries' competitiveness indices

by the price of agricultural production are presented in Table 4.

Despite the restrained growth, in comparison with other EAEU countries, of the average agricultural prices for wheat (+15.6%), this indicator in Kazakhstan has reached 223.7 thousand USD per ton, which is 40% higher compared to Belarus and 15.4% higher than the prices of Russian agricultural producers. Also, a significant increase in the value of rye production (+121.2%) was observed in 2021. Meanwhile, it should be noted that the growth dynamics of the average prices of agricultural producers in Kazakhstan for such products as barley, oats, corn grain, rice, potatoes, onions, cabbage, carrots, and pork are significantly lower than in other EAEU member countries. In general, the efficiency of agricultural production in Kazakhstan is inferior to that in Armenia and Russia (Fig. 3).

Each dollar of agricultural production in Kazakhstan accounts for 0.57 USD of the GDP. Meanwhile, in 2021, the same indicator reached 0.81 USD in Armenia and 0.66 USD in Russia.

Assessment of the impact of integration factors on the results of the development of Kazakhstan's agricultural industry

Initial data for the assessment of the integration factors affecting the gross value added of Kazakhstan's

Table 4: Competitiveness indices of EAEU countries by price of agricultural products

Types of products	Armenia	Belarus	Kazakhstan	Kyrgyzstan	Russia
Wheat	0.00	1.00	0.62	0.18	0.81
Barley	0.00	1.00	0.79	0.22	0.80
Potatoes	0.00	1.00	0.77	0.34	0.64
Onions	0.00	0.60	1.00	0.61	0.70
Cabbage	0.00	0.53	1.00	0.62	0.39
Carrots	0.00	0.97	1.00	0.63	0.98
Pome fruits	0.36	1.00	0.12	0.18	0.00
Stone fruits	0.96	1.00	0.00	0.95	0.35
Raw milk	0.70	0.84	0.76	1.00	0.00
Butter	0.00	0.75	0.59	1.00	0.34
Cattle meat in live weight	0.00	1.00	0.81	0.61	0.85
Pork meat in live weight	0.00	1.00	0.97	0.83	0.94
Poultry meat	0.00	1.00	0.88	0.71	0.88
Pasta products	0.56	1.00	0.28	0.89	0.00
Eggs	0.00	0.95	1.00	0.44	0.89

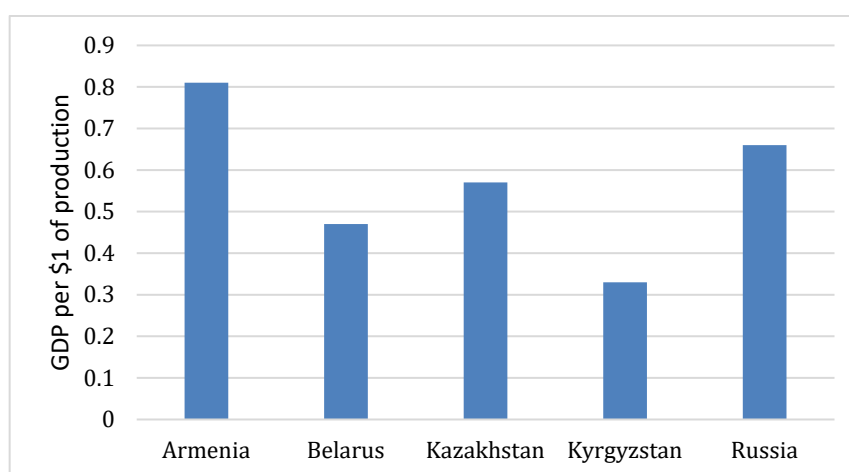


Fig. 3: Efficiency of agricultural production of EAEU countries in 2021

agricultural industry can be found in [Table 5](#).

Kazakhstan accounts for 12.8% of agricultural production in the EAEU. Over five years, the country has taken a leading position in terms of the growth rate of cattle, poultry, grain, sunflower seeds, vegetables, fruits, and berries, as well as significantly increasing its contribution to the volume of foreign trade in food products and agricultural raw materials by EAEU countries. Among the EAEU member states, Kazakhstan is the largest exporter of live farm animals and products from the flour and cereal industries. Kazakhstan takes second place after Russia in terms of grain and oilseed exports. However, the level of the country's price competitiveness in the

production of wheat, for example, is significantly inferior to Belarusian and Russian products. Also, the efficiency of agricultural production in Kazakhstan is at an average level and is currently inferior to that of Armenia and Russia. The analysis indicates that the GVA of Kazakhstan's agricultural sector has a strong positive correlation with factors such as the country's share in total agricultural production and total investment in the agricultural sector of the EAEU countries ([Table 6](#)).

Furthermore, the analysis reveals a strong relationship between the GVA of Kazakhstan's agricultural industry and the country's exports to the foreign market and the EAEU countries. Thus,

Table 5: Data for assessing the impact of integration factors on gross value added in Kazakhstan's agricultural industry

Year	GVA of agriculture (USD mln.)	Exports outside EAEU countries (USD mln.)	Share in agricultural production in the EAEU (%)	Investment in the agricultural sector of the EAEU countries (%)	Agricultural price index
2017	7,534.6	1,924.5	11.0	7.4	104.7
2018	7,883.4	2,507.5	11.6	7.1	102.8
2019	8,113.8	2,643.8	11.5	8.1	114.6
2020	9,223.6	2,697.0	12.9	9.1	113.9
2021	9,867.4	3,049.4	12.8	10.9	115.6

Table 6: Results of correlation analysis of the GVA of Kazakhstan's agricultural industry and integration factors

Variable	GVA of agriculture (USD mln.)	Exports outside EAEU countries (USD mln.)	Exports to EAEU countries (USD mln.)	Share in agricultural production in the EAEU (%)	Investment in the agricultural sector of the EAEU countries (%)	Agricultural price index
GVA of agriculture (USD mln.)	1.00					
Exports outside EAEU countries (USD mln.)	0.86	1				
Exports to EAEU countries (USD mln.)	0.83	0.98	1			
Share in agricultural production in the EAEU (%)	0.95	0.82	0.83	1		
Investment in the agricultural sector of the EAEU countries (%)	0.96	0.79	0.74	0.83	1	
Agricultural price index	0.77	0.75	0.80	0.67	0.80	1

to increase the industry's GVA, Kazakhstan needs to raise the volume of agricultural production and exports and enhance investment in the development of the industry.

Analysis of factors and barriers to the development of the agro-industrial complex for opportunities to increase food security and reduce risks

According to the results of an expert survey, the main risks of reducing food security associated with the Russian–Ukrainian conflict for Kazakh agricultural producers are higher prices for raw materials, disruptions in logistics chains, and a decrease in the price competitiveness of Kazakh products (Fig. 4).

Meanwhile, some Kazakh experts believe that the limitations associated with anti-Russian sanctions

are conducive to the development of the national economy and an impetus for expanding the volume of domestic agricultural production. Most experts (73.5%) argued that the present conditions call for an enhancement of cooperation and mutual trade within the EAEU. In turn, only 8.8% of the experts asserted that it is necessary to loosen ties within the EAEU and move to other, non-sanctioned markets. Most of the surveyed experts believe that the sanctions related to the Russian–Ukrainian conflict offer a set of opportunities for the development of the national market for agricultural products. The most notable possibilities indicated by the experts were the chances of increasing exports to foreign markets and expanding the volume of mutual trade with EAEU countries (Fig. 5).

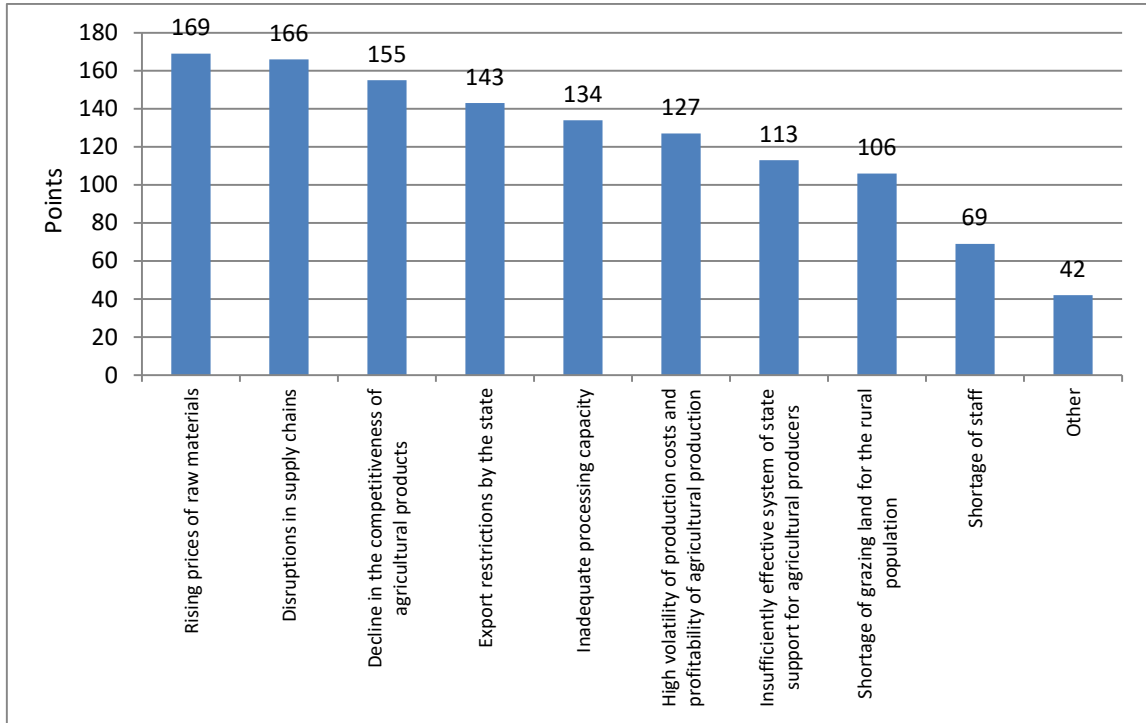


Fig. 4: The main risks of agricultural production in Kazakhstan associated with special operations in Ukraine

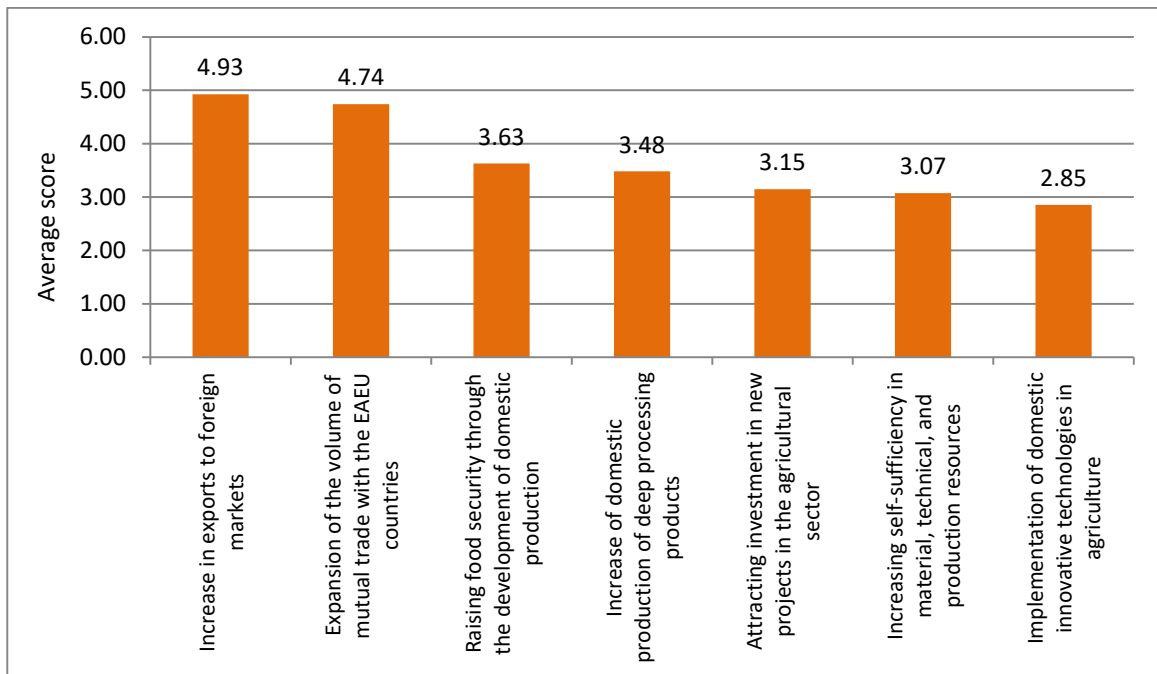


Fig. 5: Opportunities for the development of Kazakhstan's agricultural industry, average

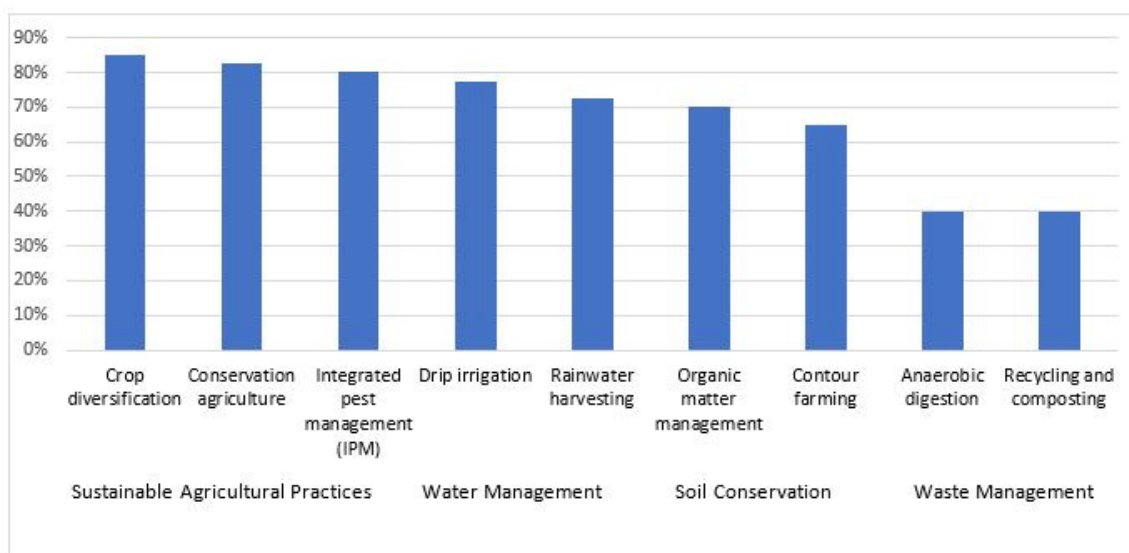


Fig. 6: Expert opinion on the risks of reducing the level of environmental safety

Also, in the experts' opinions, the sanctions imposed by Western countries will give an impetus to reinforce integration within the EAEU and contribute to the development of domestic agricultural production and deep processing products. However, according to experts, the intensive development of the agro-industrial complex in Kazakhstan can reduce the level of environmental safety. Therefore, experts believe that it is necessary to monitor and orient producers to use sustainable agricultural practices, water management, soil conservation, and waste management, which in turn include some measures (Fig. 6).

Based on the results of the study, to overcome the main risks of the agro-industrial complex to ensure food security and environmental safety, the following measures are recommended:

1) Creation of alternative routes for the import and export of goods bypassing the territory of Russia and expanding trade partners

What may become a promising logistics project for Kazakhstan is the creation of the Trans-Caspian Transport Route (TCTR). This can help diversify the country's trade relationships and reduce dependence on any one country. This multimodal route, which utilizes rail and sea transport, was established in 2017 and currently runs through the

Caspian Sea, Azerbaijan, Georgia, and Turkey toward the Black Sea and on to Europe. The path across the Caspian Sea will allow Kazakhstan to solve logistical problems arising from anti-Russian sanctions. Also, through the development of logistics chains, China has recently become one of the largest trading partners in Kazakhstan. Both countries have set a goal to increase their bilateral trade volume to \$35 billion by 2030 (Silk Road Briefing, 2023). China is interested in importing agricultural products from Kazakhstan, increasing the volume of rail transport, and enhancing inter-regional cooperation and partnership (World of NAN, 2023).

2) Improve the technological level of the agricultural industry through the creation and development of domestic breeding and genetic resources.

Experts note that Kazakh varieties currently occupy only 5% of the 25 million hectares of arable land, while foreign varieties account for 95% (OISPMRK, 2022). Breeding in the country largely relies on the scientific heritage of the Soviet period. There is a shortage of specialists and scientist breeders, and the issues of royalties and copyrights are acute (Burna-Asefi, 2022). Furthermore, state support for scientific and educational organizations engaged in research and innovative development in the field of breeding and genetics is quite poorly developed in Kazakhstan. It

is necessary to improve current legislation, create conditions for the establishment of new seed farms, and foresee the need to introduce financial instruments to address the problems highlighted. A plan for the introduction of new varieties must be developed at the level of the Ministry of Agriculture of Kazakhstan, departments of agriculture, and agricultural research organizations (Esmagulova et al., 2023) and includes the development of sustainable agricultural practices (Dashkevich et al., 2022). Such measures as crop diversification and conservation agriculture help to reduce the risk of crop failure, improve soil health, and provide a more stable income for farmers (KASE, 2021).

3) Development of domestic fodder bases and the production of fodder additives

Experts believe that Kazakhstan can become the largest exporter of livestock products, but a significant obstacle is the lack of a fodder base (Iurchenko, 2015). When determining the structure of sown areas, it is important to consider not only natural and climatic conditions but also the need for agricultural producers in certain fodders and the technology for their procurement. Developing rangeland management practices and introducing legumes into crop rotation can fix atmospheric nitrogen, improve soil health, and reduce the need for synthetic fertilizers (Bayazitova et al., 2023).

One topical direction is the development of partnerships with both EAEU and other countries for the development of Kazakhstan's own microbiological industry to produce vitamins and amino acids, as well as an increase in the use of protein components and secondary raw materials for the food and processing industry to reduce the proportion of forage grain. It is also necessary to legislatively unify the requirements for the quality of feed and feed additives, which are essential for veterinary and sanitary expertise.

4) Development of industrial cooperation in the field of agricultural engineering

At present, due to the introduction of measures to stimulate the agricultural machine-building industry, world producers, such as Rostselmash, Petersburg Tractor Plant (Russia), Gomelselmash, MTZ (Belarus), Lovol Heavy Industry, Yto Group Corporation (China), CLAAS Gmh (Germany), and SDF Group (Italy),

have localized their production on the territory of Kazakhstan. Despite the growth in the production of agricultural machinery for national assembly, the agricultural machine-building industry still faces problems associated with a high depreciation rate of machinery, its utilization, subsidized investments in the renewal of agricultural machinery and interest rates, and the transfer of field machinery in leasing. Insufficient funds lead to the maintenance of worn-out equipment in poor conditions, which has a negative impact on labor productivity and the cost of agricultural production (Kornilova et al., 2022). Moreover, it is crucial to establish an effective system for waste disposal and soil conservation measures to improve environmental safety (Tatibekova et al., 2022).

5) Increase the level of environmental safety in the agro-industrial complex of Kazakhstan

The agro-industrial sector handles a significant proportion of greenhouse gas emissions, water usage, and pollution; thus, improving its environmental performance is essential to mitigate these impacts. Kazakhstan has traditionally focused on wheat production, which has contributed to soil degradation and increased vulnerability to pests and diseases. As mentioned by experts, crop diversification could improve soil health and reduce the risk of crop failure due to weather and pest-related problems. Diversifying crops also provides farmers with a more stable income and a single crop, which is particularly important given the "extreme" continental climate of the country (Yesmagulova et al., 2023). Conservation agriculture involves reducing tillage and using cover crops to conserve moisture, reduce erosion, and improve soil health. Integrated pest management reduces pesticide use and improves soil and water quality, while drip irrigation reduces water usage and minimizes soil erosion. All of these measures contribute to environmental sustainability and can reduce the impact of agriculture on the environment and human health (Khan et al., 2018). In addition to these measures, other actions can be taken to improve the environmental safety of the agro-industrial complex. For example, promoting organic farming practices can reduce the use of agrochemicals and improve soil health. Supporting agroforestry and reforestation efforts can also contribute to improving ecological

balance and enhancing biodiversity (Dambaulova *et al.*, 2022). Furthermore, investing in the research and development of sustainable agricultural practices and technologies can help to identify new and innovative ways to improve the environmental performance of the agro-industrial complex.

CONCLUSION

For Kazakhstan, the agricultural sector, rural areas, and the EAEU market are the most important components in ensuring the sustainable and inclusive growth of the Central Asian region. A year ago, researchers predicted that the EAEU could help eliminate the distortions and disproportions that have developed over the past decades, especially on the Eurasian continent. The geopolitical risks that have arisen over the past year have made significant changes in the integration ties between countries, violated food security, and may have an impact on and significantly reduce the country's environmental security. Geopolitical risks for Kazakhstan as one of the members of the EAEU include rising prices for raw materials, disruptions in supply chains, high volatility in the cost of agricultural products, and the availability of goods and materials. Currently, agricultural production in Kazakhstan is highly dependent on the import of breeding and genetic resources, plant protection products, and agricultural machinery. The risks of a transport blockade will reduce the availability of imported goods and materials for agricultural production and the volume of exports of agricultural products and food products from Kazakhstan to EU countries. This, in turn, may discourage investment in this sector and slow down the growth of the agricultural sector. To ensure food security, Kazakhstan needs to pursue a multivector integration policy capable of solving priority tasks in solving transport and logistics problems, development problems in the field of breeding and genetics, a lack of a forage base, and the development of engineering. Such a policy could lead to the international reintegration of Kazakhstan and have an impact on the sustainable development of the country's rural sector. An important conclusion of this study is that, when taking emergency measures to solve the identified problems, it is important to pay attention to the level of environmental safety. Crop diversification, conservation agriculture, integrated

pest management, and drip irrigation are important measures to increase environmental safety in Kazakhstan's agro-industrial complex. The adoption of a range of measures and actions could contribute to achieving the goal of environmental safety. By improving the environmental performance of the sector, Kazakhstan could achieve sustainable economic growth, enhance food security, and contribute to the quality of life of the population. Limitations of this study include the statistics used from various countries within the EAEU (Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia), which may lead to inaccuracies in their analysis when combined. However, it was not considered to have a significant impact on the findings. In terms of prospects for research, it is necessary to further develop each direction highlighted in the study to improve environmental safety and food security. Increasing the level of environmental safety of the agro-industrial complex of Kazakhstan through measures such as crop diversification, conservation agriculture, integrated pest management, drip irrigation, and other sustainable agriculture practices could help reduce the industry's impact on the environment while enhancing food security. Further research and development in these areas could help Kazakhstan achieve its goals of sustainable economic growth.

AUTHOR CONTRIBUTIONS

L.A. Omarbakiyev and S.M. Kantarbayeva performed the literature review, experimental design, analyzed and interpreted the data, prepared the manuscript text, and manuscript edition. A.K. Nizamdinova and S.T. Zhumasheva performed the experiments and literature review, compiled the data and manuscript preparation. G.Z. Seitkhamzina helped in the literature review and manuscript preparation. A. Saulembekova performed some of the remained experiments.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism,

informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

USD

United States Dollars

WTO

World Trade Organization

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ABBREVIATIONS

%	Percent
COVID-19	Coronavirus disease 2019
EAEU	Eurasian Economic Union
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GVA	Gross value added
IFOAM	International Federation of Organic Agriculture Movements
Mln.	Million
q/ha	Quintals per hectare
ths. tn	Thousands of tonnes
TCTR	Trans-Caspian Transport Route
UN Comtrade	United Nations International Trade Statistics Database

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