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Food security in Kazakhstan and Azerbaijan: Challenges and strategies for economic and sustainable development

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ABSTRACT

The study aims to analyse the current mechanisms of state regulation of food security in Kazakhstan and Azerbaijan to identify and assess their effectiveness. Among the methods used were analytical, statistical, functional, method of system analysis, deduction, synthesis, and comparison. A comparative analysis of state regulation of food security in Kazakhstan and Azerbaijan was conducted, leading to recommendations for enhancing regulatory measures. Suggestions include integrating new agricultural technologies, fostering international partnerships, and learning from other nations' exfperiences. The study also highlighted opportunities for sustainable agricultural development, product quality improvement, and ensuring food accessibility across various population segments in both regions.

Keywords*: Agriculture; policy effectiveness; international standards; international cooperation; sustainable development.*

1 Introduction

In the modern world, issues related to food security are coming to the forefront, requiring more and more attention and decisive action on the part of states and the international community. This is determined not only by constant population growth but also by dynamic changes in the economic, climatic, and social environment, which have a direct impact on the availability and sustainability of the food market.

In the context of countries in the development stage, such as Kazakhstan and Azerbaijan, food security issues are of particular importance. Kazakhstan is facing domestic food security challenges despite its ambitions to play a significant role in global food security (Samoilenko et al., 2022). These challenges, which include food inflation and climate-related problems, are hindering the country's aspirations. Kazakhstan has invested heavily in its agriculture and food production sectors to diversify its economy away from over-reliance on oil and gas (Kerimkhulle et al., 2023; Khashimova et al., 2020). Kazakhstan exports important commodities such as wheat, oil-bearing crops, meat, and dairy products (Tukhtabaev et al., 2023). However, concerns have been raised about the country's ability to ensure its own food security due to internal issues such as delays in addressing grain quality and subsidies for egg production. Kazakhstan has faced challenges in various food production sectors due to factors driven by climate change and subsidy issues. These challenges have affected areas such as wheat production and the sustainability of the egg industry (Shaku, 2022). Additionally, the recent war in Ukraine and subsequent sanctions against Russia have exacerbated food inflation in Kazakhstan, adding another layer of complexity to the situation (Johannes Andree et al., 2024).

Similarly, the agricultural sector in Azerbaijan is crucial to the livelihoods of 20-50% of the population. This underscores the importance of agriculture to Azerbaijan's economy and highlights the potential impact on the country's food security (Food and Agriculture Organization of the United Nations, 2019). The situations in Kazakhstan and Azerbaijan highlight the need for robust and resilient food systems to ensure food security, both domestically and globally.

The research problem in this area represents a wide range of issues. First and foremost, it includes a thorough analysis of the effectiveness of the current mechanisms of state regulation of food security in these countries. This includes an examination of existing legislation, policy strategies and programmes aimed at supporting agriculture, as well as an assessment of their compliance with international standards and their effectiveness in ensuring the stability and availability of food for the population. It also covers areas related to changing climatic conditions, the impact of environmental factors, fluctuations in food prices, as well as uneven agricultural development and inadequate agricultural infrastructure. All these aspects require comprehensive research and targeted strategies to ensure sustainable and reliable nutrition for all segments of the population in these countries.

2 Literature Review

Kazhiyeva and Zhailaubayeva (2022) argue that strengthening state support for agriculture in Kazakhstan will lead to a significant increase in food production. Their study shows that the introduction of modern technologies, training farmers in new methods and supporting financing for the development of infrastructure of agricultural enterprises will play a key role in ensuring the stability and availability of food for the population. Saparova (2023) conducted an analysis demonstrating that investments in the development of sustainable farming technologies in Kazakhstan can significantly increase crop yields and reduce vulnerability to climate change. The author emphasises the importance of adopting modern agro-technologies, water-efficient practices, and improved irrigation systems to ensure food security in a changing climate. Klimov et al. (2023) studied the consumption market in the country and concluded that there is a need for a diversity of products offered and the introduction of modern methods of storage and transport. This study highlights the importance of improving the infrastructure to preserve the freshness and quality of products in the supply chain, providing the population with greater access to diverse and high-quality food. Sabyr and Abilkaiyr (2021) analysed social support measures in Kazakhstan. They concluded that it is necessary to create a more effective system of assistance to low-income groups of the population to ensure their access to food. Their study highlights the importance of social programmes aimed at combating inequality and ensuring the basic nutritional needs of citizens. Abdykaliyeva et al. (2021) conducted an analysis emphasising that the development of cooperative forms of farming in Kazakhstan can contribute to increasing production efficiency and improving the living conditions of the rural population.

Although existing research addresses different aspects of food security, there remains a notable gap in understanding the impact of global economic changes and socio-cultural factors on food security in Kazakhstan and Azerbaijan, and in formulating adaptation strategies. Therefore, this study will examine in detail the multiple impacts of global economic changes and socio-cultural dynamics on food security in these countries. At the same time, it will identify strategies for skilfully navigating these changes and strengthening public management mechanisms to enhance food security.

3 Materials and Methods

3.1 Data sources

Official documents and reports on state regulation of food security in Kazakhstan and Azerbaijan, such as laws, strategic plans, programme implementation reports and other documents of official bodies and institutions responsible for food policy were used as the material base (Law of the Republic of Azerbaijan No. 759-IQ "On Food Products", 1999; Law of the Republic of Kazakhstan No. 301-III "On Food Safety", 2007; Code of the Republic of Kazakhstan No. 360-VI "On the health of the people and the healthcare system", 2020; Living standards statistics, 2023; Azerbaijan – Food Security and Nutrition Indicators, 2024). This approach ensures the reliability and validity of the data presented and allows for the analysis of official strategies and measures implemented in the field of food policy in both countries.

3.2 Research methods

The scientific research on the study of topical issues of food security was carried out using methods that reveal the content of the object. The analytical method was used to study various aspects of political strategies, legislation, agricultural support programmes, market trends, infrastructure and other factors affecting food security. Key aspects were identified, and interrelationships were established between different variables and elements of the food security system to gain a deeper understanding of the problem. The statistical method was used to examine data and indicators related to food production, consumption, and availability. This includes data on agricultural production, poverty level of financial accessibility, purchasing power, food consumption and other statistical indicators. Using the functional method, the role of various structures and organisations involved in food security was studied. This includes examining the functions of government agencies, local authorities, non-governmental organisations, and the private sector in supporting food security. The system analysis method was used to examine the food security system as an interconnected network of elements: production, distribution, consumption, and availability of products. This method also assessed the interaction of various factors and their impact on the overall system. Using the deduction method, generally recognised positions were analysed, and logical links were established between the various factors contributing to food stability and availability in Kazakhstan and Azerbaijan. The synthesis method was used to combine different sources of information and data to create a holistic picture. In this case, synthesising data on different aspects of food security allows for a comprehensive understanding of the problem. The comparison method was used to compare different approaches, strategies or models used in different countries or regions to identify and evaluate their benefits and challenges, as well as to develop recommendations for their improvement in the study field.

3.3 Focus and scope of the study

This study focuses on economic methodology, analysing several key aspects and parameters to better understand the state regulation of food security in Kazakhstan and Azerbaijan. Certain aspects, such as economic availability of food, poverty levels, income concentration, consumption of agricultural products and investment in agriculture, were selected for analysis because they are key indicators of economic sustainability and food security. The choice of the period of analysis was driven by the need to assess long-term trends and changes in the economy affecting food security. As a result, these actions were applied to consider the feasibility of developing state regulations for the successful development of the food sector in Kazakhstan and Azerbaijan.

4 Results

4.1 Elements of state regulation and public policy to ensure food security

Food security is a fundamental concept that reflects a society's ability to ensure that its population has access to sufficient, safe, nutritious, and diverse food. It has many aspects, ranging from physical access to nutritional quality and stability, and is key to the health and well-being of every individual (Cole et al., 2018; Studinska and Studinski, 2023). The first aspect of food security is physical access to food. This means that food must be available to all members of society in sufficient quantities and at affordable prices. The basic element is the fulfilment of basic food needs necessary to maintain health and normal functioning of the body (Madiyarova et al., 2013). Economic access to food is the next aspect. It is the provision of income and stability so that everyone can afford to buy enough food. Economic stability is necessary to prevent poverty and hunger (Martin-Shields and Stojetz, 2019; Nuzhna and Tluchkevych, 2019). Food quality is another important component. Food must be safe to eat and contain the necessary nutrients. Guaranteeing food safety is related to the absence of hazardous chemical and biological substances that can be harmful to health (Shemet and Hulai, 2023; Mukhametov et al., 2023). Finally, nutritional stability is about ensuring that food is always available regardless of external factors. This includes maintaining stable food production to cope with the variability of climatic conditions, economic fluctuations and other factors that can affect food availability (Rozaki, 2021). Food security is not only the fundamental right of every human being to decent food but also the basis for the sustainable

development of society (Balji, 2023). It is essential for health, social stability, and economic development. Working towards food security is one of the most important areas that society must devote special attention to achieve sustainable and equitable development (Béné, 2020).

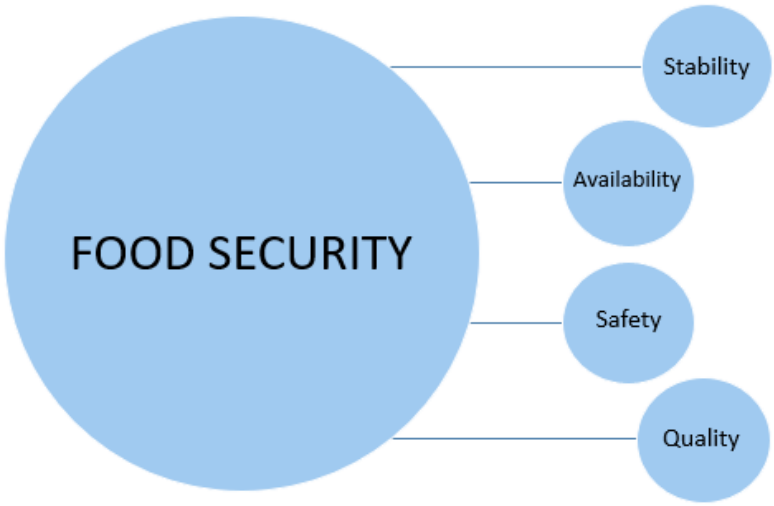

Figure 1. Elements of food security.

Food security, recognized as a crucial domain of public policy, necessitates a framework of state regulation aimed at guaranteeing the stability, accessibility, quality, and safety of food. The next element is food safety supervision and control, which includes regular inspections of food processing facilities, analysing food samples, and checking that they meet safety standards. This aims to ensure the safety and quality of food that enters the market (Guo et al., 2019). The government also conducts educational programmes and information campaigns to raise awareness of hygiene and safety rules among the public and food workers (Skydan et al., 2023). Support of agriculture and the development of rural programmes are also part of the state policy. The state develops and implements agricultural support programmes aimed at increasing yields, developing infrastructure and technology, and reducing losses in production (Kuralbayeva et al., 2023). States also join international agreements and organisations to comply with international standards of food quality and safety, which is important to ensure the safe circulation of products in domestic and global markets. Economic support mechanisms, such as subsidies, loans, or investments, influence the development of the food industry and ensure the stability of food prices (Grace, 2015; Horbal and Makarova, 2023). These elements, structured into a system of State regulation, aim to create a sustainable, safe, and quality food system for society. They constitute the fundamental basis for food security and are key elements of States' strategy on this important issue.

The Committee for the Control of Quality and Safety of Foodstuffs and Goods in Kazakhstan and Azerbaijan conducts inspections through various mechanisms to ensure food safety and quality. In Azerbaijan, the Food Safety Agency is responsible for implementing state policy and regulation in food safety. The agency conducts regulatory veterinary and phyto-sanitary control, issues certificates, and carries out state control over consumer rights, among other duties. Inspections are undertaken at all stages of the food chain, including production, storage, packaging, transport, and turnover (International Trade Administration, 2024).

4.2 Food security indicators in Kazakhstan

Similarly, in Kazakhstan, the quality and safety of food products must conform to normative documents. State authorities at border checkpoints implement control over food products to prevent the supply of low-quality or dangerous goods to consumers. Physical and legal entities involved in the circulation of food products have rights and duties related to ensuring compliance with sanitary rules and norms. These measures aim to safeguard public health and ensure the quality and safety of food products in both countries (Law of the Republic of Kazakhstan No. 301-III "On Food Safety", 2007).

State regulation of food security in Kazakhstan includes a range of measures and legislative acts to ensure the quality and safety of food products, as well as their availability to the population. One of the key documents regulating the quality of food products is Law of the Republic of Kazakhstan No. 301-III "On Food Safety" (2007). This law establishes quality and safety standards for the production, storage, and transport of food. For example, the Code of the Republic of Kazakhstan No. 360-VI "On the health of the people and the healthcare system" establishes safety standards for food products and control over their production (2020). The country has a system of state control over the quality and safety

of food products. For example, the Committee for the Control of Quality and Safety of Foodstuffs and Goods regularly conducts inspections at enterprises and shops to ensure that products meet the established standards. Food products that have been certified and meet established standards are labelled and certified accordingly. For example, products with international quality certificates such as ISO 22000 confirm their compliance with global food safety standards.

The state conducts educational programmes and campaigns to raise public awareness of proper nutrition, hygiene, and the choice of safe food products. Kazakhstan actively joins international organisations and adheres to international standards for food quality and safety. Cooperation with the World Health Organisation and other international organisations helps in the adoption of best practices and standards in this area. Table 1 presents indicators that assess the state of food security in Kazakhstan.

Table 1.
Food security indicators in the Republic of Kazakhstan for 2018-2022

Value	2018	2019	2020	2021	2022
Financial access to food					
Consumer expense ratio	0.55	0.55	0.52	0.52	0.51
Financial food accessibility coefficient for the employed population	0.09	0.09	0.09	0.09	0.09
Coefficient of financial accessibility of food for pensioners	0.27	0.26	0.26	0.25	0.26
Economic food accessibility					
Poverty coefficient	0.04	0.04	0.04	0.04	0.03
Purchasing power coefficient of household income	0.29	0.28	0.28	0.28	0.27
Income concentration ratio (Gini index)	0.28	0.27	0.28	0.28	0.27
Food affordability coefficient	0.16	0.16	0.15	0.15	0.15
Food availability and sufficiency indicators for food consumption					
Crop production	0.72	0.73	0.75	0.75	0.77
Animal husbandry products	0.85	0.85	0.85	0.86	0.87
Improved water source access, % of population	92.8	93	93.1	93.1	93.4
Investments aimed at “green economy” in Agriculture, forestry, and fishery, million tenge	50.7	61.2	24.2	72	120
Agricultural resource potential					
Financial resources/State support for agro-industrial complex and agriculture, billion tenge	1102.5	1022.4	1201.1	1470	2801.1
Fixed capital investment in food production, billion tenge	111.8	82.8	95.4	110.7	132.8
The volume of innovative products produced in the “Food production” sector, billion tenge	39433.7	42112.2	39571.1	45821	46825.6

Source: compiled by the author based on the Living standards statistics (2023).

The consumer expenditure and food affordability ratios for the employed population and pensioners are gradually decreasing, which may indicate that the cost of food products is increasing in comparison with the population’s income. The poverty rate remains relatively stable, which may indicate that social stability among the population has been maintained. However, the purchasing power ratio and income concentration show a slight decline, which may indicate an increase in social inequality in access to food. Crop and livestock products show a steady growth trend, indicating an increase in food production in the country. Significant fluctuations in investment in the green economy and state support for the agro-industrial complex and agriculture reflect various changes in financial policy and agricultural development priorities. The volume of innovative products produced in this sector is gradually increasing, which indicates the desire for modern technologies and the development of the food industry. In general, these indicators reflect the complex picture of food security in Kazakhstan.

4.3 Food security indicators in Azerbaijan

State regulation of food security in Azerbaijan is also based on legislative acts and measures aimed at ensuring the quality, safety, and accessibility of food for the population. Legislation such as Law of the Republic of Azerbaijan No. 759-IQ “On Food Products”, regulates the standards of quality and safety of food products (1999). This law establishes requirements for the production, storage, transport, and sale of products. For example, the Agency for Standardisation, Metrology and Certification conducts inspections for compliance of products with standards and issues quality certificates. State control is carried out by the State Service for Food Quality Control. They regularly inspect enterprises and retail outlets to confirm that products comply with established standards. For example, if deficiencies or violations of standards are found, the state takes measures to correct the situation or close down the enterprise (Azerbaijan – Food Security and Nutrition Indicators, 2024). The certification system ensures that products that meet the standards

are labelled. Products that have received quality certificates, such as AZS (Azerbaijan Standard), attest to the conformity of products with established safety standards.

Educational activities are also organised to raise public awareness of the basics of healthy eating and food safety. Seminars, training sessions and the distribution of information materials on the subject are organised. Azerbaijan actively cooperates with international organisations, such as the World Health Organization, considering international standards and practices in the area of food safety. Such cooperation helps the country to use best practices and experience in this area to improve measures to ensure food safety and quality. Table 2 presents indicators that assess the state of food security in Azerbaijan.

Table 2.
Food security indicators in Azerbaijan for 2018-2022

Value	2018	2019	2020	2021	2022
Financial access to food					
Consumer expense ratio	0.54	0.55	0.55	0.56	0.56
Financial food accessibility coefficient for the employed population	0.1	0.1	0.11	0.11	0.1
Coefficient of financial accessibility of food for pensioners	0.25	0.25	0.24	0.24	0.23
Economic food accessibility					
Poverty coefficient	0.05	0.06	0.05	0.04	0.03
Purchasing power coefficient of household income	0.3	0.3	0.29	0.29	0.27
Income concentration ratio (Gini index)	0.26	0.25	0.25	0.26	0.24
Food affordability coefficient	0.17	0.17	0.17	0.16	0.16
Food availability and sufficiency indicators for food consumption					
Crop production	0.7	0.71	0.72	0.75	0.76
Animal husbandry products	0.8	0.8	0.82	0.85	0.83
Improved water source access, % of population	93	93.2	93.4	93.6	93.8
Investments aimed at “green economy” in Agriculture, forestry, and fishery, million manat	-	-	-	-	-
Agricultural resource potential					
Financial resources/State support for agro-industrial complex and agriculture, million manat	905.5	825.2	705.2	890.1	1105.2
Fixed capital investment in food production, million manat	78.2	75.2	54.1	82	85.9
The volume of innovative products produced in the “Food production” sector, billion manat	-	-	-	-	-

Source: compiled by the author based on the Azerbaijan – Food Security and Nutrition Indicators (2024).

The coefficient of consumer expenditures, which characterises the share of the population’s income spent on food, shows a steady upward trend. The coefficients of financial accessibility for the employed population and pensioners also indicate changes in consumer opportunities. There is a positive trend in the reduction of the poverty coefficient, while the purchasing power and income concentration coefficients emphasise the increasing affordability of food. Increases in crop and livestock production indicate an increase in the country’s self-sufficiency in domestically produced food. Improved access to water resources maintains sanitation standards. Steady increases in financial resources and investment in agriculture indicate government support for the sector.

4.4 Challenges and recommendations for food security

Some certain challenges and problems may have an impact on food security in these countries. In Kazakhstan, one of the challenges is the changing climatic situation, which can lead to instability in agriculture. Extreme weather conditions, such as droughts or floods, can reduce crop yields and worsen conditions for agricultural activities. In turn, in Azerbaijan, in addition to climatic challenges, there is the problem of limited water resources, which can hurt agriculture. Irrational use of water and insufficient infrastructure for water storage and distribution can threaten the sustainability of agricultural systems. Another significant challenge for both countries is the uneven development of agriculture and infrastructure in different regions. This can cause uneven access to resources, education, and support, making it difficult to achieve overall food stability. Furthermore, both countries face the problem of outdated infrastructure in the agricultural sector, which limits the possibilities of modern agriculture and may slow down the introduction of innovations.

Based on the analysis of previous studies and current challenges, it is possible to propose several recommendations that can contribute to improving the situation. One of the key aspects of improving state regulation is to support innovation in agriculture. States should encourage the introduction of new technologies, improved production methods and modern resource management techniques (Musayeva et al., 2022; Madiyarova et al., 2019). For example, in Kazakhstan, the introduction of precision farming and the use of drones to monitor fields are already yielding positive

results, improving production efficiency. However, adequate infrastructure is needed to fully realise innovations. The lack of infrastructure in rural areas is a notable constraint to efficient agriculture. States should pay attention to the development of road networks, water supply systems, agricultural storage, and processing. Active implementation of road network development projects in countries, including in remote rural areas, will facilitate easy access to markets and reduce transport costs for agricultural products (Bozsik et al., 2022; Kerimkhulle et al., 2022).

The development and implementation of sustainable land management practices help to preserve soil fertility and reduce negative environmental impacts. States should carefully regulate the use of land resources, including by promoting organic farming. For example, Uzbekistan is introducing soil conservation and water management practices in agriculture. These practices help prevent erosion and improve soil quality. The social aspect of agriculture also plays an important role. Providing access to education and upgrading the skills of agricultural workers contributes to effective farm management. States can provide subsidies or incentives for the training of agricultural professionals. States can provide financial support to farmers through subsidies for the purchase of equipment, seeds, fertilisers, and other necessary inputs (Herforth and Ahmed, 2015). This can contribute to the stability of production and increase the profitability of agricultural enterprises.

An effective early warning system, implementation of monitoring and data analytics in agriculture in Kazakhstan and Azerbaijan can help to promptly identify and analyse potential problems such as plant diseases or changes in climatic conditions, ensuring timely action to prevent crises. The storage and distribution system are also undergoing modern changes. The introduction of modern technologies in storage and logistics systems in countries can help improve supply chain efficiency and reduce product losses. Finally, the establishment of strategic food reserves on a national scale in resilient markets in countries can be a very effective mechanism to mitigate the effects of economic or natural disasters.

The analysis confirms that emerging economies, particularly Kazakhstan and Azerbaijan, face unique challenges in ensuring food security. Despite significant potential in the agricultural sector, these countries struggle with several challenges, including uneven development, the impact of climatic factors and food price instability. Statistical indicators examined in the context of financial and economic access to food show that the effectiveness of government regulation in these countries shows certain trends. The assessment of purchasing power ratios, income concentration and food availability provides a basis for further policy improvements in this area.

The study shows that one of the key aspects highlighted in the recommendations is infrastructure development. The case studies from Kazakhstan and Azerbaijan emphasise the importance of investment in agriculture, as well as in agricultural storage and transport infrastructure. Recommendations to build strategic food reserves in times of crisis are supported by evidence of investment in agriculture, forestry, and fisheries. This is important to ensure the stability of the food supply in times of instability. Analyses of challenges such as climate change, and socio-cultural and environmental factors emphasise the need to pay attention to the adaptation of agriculture to changing conditions. At the same time, the unique characteristics of each country should be considered when designing measures to increase the resilience of the agricultural sector. The results of the study make an important contribution to understanding the complexity of food security in developing countries. The importance of international cooperation and exchange of experiences for the development and effective implementation of food security strategies is highlighted.

5 Discussion

Barrera and Hertel (2021) scrutinised the financial accessibility of food and focused on key indicators such as consumer expenditure ratios. They examined how these ratios have changed over time and how they vary for different social groups, including the employed population and pensioners. The results of the analysis indicate a certain increase in the consumer expenditure ratio, which may indicate an increase in the level of income in society. However, the authors noted that despite this increase, the availability of food for the employed population and pensioners remains at a level that requires careful regulation. The results of the current study, as well as those of the mentioned researchers, point to the need to strengthen public support measures and food price regulation to ensure stable access to food for different social groups. There is a need for more differentiated and targeted approaches to financial support for different segments of the population, considering their social characteristics.

Monterrosa et al. (2020) analysed the sociocultural aspects that influence food security. Their main focus was on cultural characteristics and their influence on food choice and consumption. The authors also raised the issue of food preferences in different sociocultural groups in society, which can significantly influence consumption patterns and dietary balance. Different cultural contexts can pose unique challenges to food security in each country. This may include not only differences in food preferences but also traditions of food production, processing, and distribution. Recommendations for improving food security could include tailoring government support programmes to the socio-cultural specificities of each population group. For example, support for local food production traditions or advertising campaigns that target the consumption habits of different socio-cultural groups can increase the effectiveness of food security measures.

Hoffmann et al. (2019) conducted a detailed analysis of the effectiveness of state regulation of food security, focusing on legislation, policy strategies and agricultural support programmes. Their approach included an assessment of the compliance of these activities with international standards and their effectiveness in ensuring food stability and availability. They assessed the extent to which legislation complies with the requirements and recommendations of global food security organisations. The authors also examined political strategies aimed at ensuring food security as well as agricultural support programmes. The authors' study can serve as a basis for further improvement of government food security strategies and programmes. Transparency and systematic examination of legislation, policy strategies and agricultural programmes will help to identify areas for further improvement.

Koul et al. (2022) highlighted the current imbalance between agriculture and environmental sustainability. They found that climate change can significantly affect the production cycles of agriculture, which in turn has an impact on food security. The authors highlighted the need to develop and implement sustainable farming practices that help to preserve soil fertility and reduce negative environmental impacts. They also emphasised the importance of regulating land use, calling for the active adoption of organic farming and other environmentally friendlier practices. The author's results show the importance of taking environmental aspects into account when developing strategies to ensure food security in the countries under consideration. Similar to the study by the researchers, the author's results point to the need for careful consideration of environmental factors that may affect agriculture and, as a consequence, food availability and sustainability.

Brockova et al. (2021) analysed in depth in their study the issues of public investment in innovation and technology in agriculture. Their main focus was on the volume of investments aimed at the "green economy" in agriculture, as well as the assessment of their impact on increasing efficiency in this industry. The authors looked in detail at what specific programmes and policies have been implemented to stimulate innovation in the agricultural sector. They analysed successful cases and highlighted the main factors contributing to improved production and increased profitability of agricultural enterprises. Public investment in innovation and green technologies can indeed play a key role in improving agriculture (Stepanenko et al., 2023; Anarbayev et al., 2023). Examples of successful technology deployments, such as modern irrigation techniques, automated farm management systems and technologies to optimise production, confirm the potential of these investments to improve the productivity and sustainability of the agricultural sector.

Pliakoura et al. (2020) emphasised the importance of education and training in agriculture. Their analysis included not only the current state of the education system intended for agricultural workers but also recommendations for its improvement. The authors examined in detail the training programmes provided for specialists in the agricultural sector, assessing their relevance to the current requirements and challenges facing agriculture under changing climatic and economic conditions. Education is essential for effective farm management, innovation, and sustainable development of the agricultural sector. The author's study provides valuable recommendations for the development and implementation of strategies in agricultural education, which can lead to improved skills and competencies of workers in agriculture, ultimately contributing to improved food security in various countries.

In general, the reviewed studies reveal complex aspects of food affordability, socio-cultural and environmental factors, as well as the effectiveness of state regulation and investment in the agricultural sector. The totality of these studies points to the complexity of the food security problem and highlights the importance of an integrated approach in developing strategies and implementing programmes to ensure the sustainability of agriculture, improving human resources, as well as addressing socio-cultural and environmental factors.

6 Conclusions

This study examined key aspects of food security in Kazakhstan and Azerbaijan. The study highlights the definition of food security, emphasising its physical access, economic access, food quality and sustainability. It is emphasised that food security is not only the basic right of every person to decent food but also the foundation for the sustainable development of society. The main elements of state regulation of food security are presented in the form of legislation, food safety controls, educational programmes, and agricultural support. These measures aim to ensure the stability, availability, quality, and safety of food in society. International cooperation and support for innovation in agriculture are also important components.

Analyses of food security indicators in Kazakhstan and Azerbaijan presented in the tables indicate some trends and challenges. Keeping poverty levels stable, increasing agricultural production and attention to environmental and water issues are positive developments. However, given the changing climate, limited water resources and uneven agricultural development, certain challenges arise. Based on the analysis of the identified challenges, recommendations are proposed to improve the situation. Among the key measures, the active promotion of innovation in agriculture, development of infrastructure in rural areas, regulation of sustainable land use, ensuring access to education for agricultural workers, financial support for farmers and creation of effective monitoring and storage systems are suggested. The overall conclusion emphasises the complexity of the food security challenge, the need for an integrated

approach and strong innovation to ensure sustainable agriculture and achieve food security goals in the foreseeable future.

Further research could focus on adapting agriculture to climate change, introducing digital technologies, exploring socio-cultural aspects of food consumption, and developing effective economic support mechanisms for farmers. Assessing the effectiveness of implemented strategies and building strategic food reserves can also be key areas for ensuring stability and sustainability of food security in the region.

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