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Development of the Agricultural Sector as a Factor of Ensuring Food Security of Kazakhstan in the Context of the EAEU[1]

In the framework of the integration associations, each state must ensure, first of all, its food security with the economically feasible development of the agricultural sector of the national economy. This study examined the food security of the Republic of Kazakhstan in the context of the integration of the Eurasian Economic Union members. The study proposes a method for calculating an integral indicator of food security in Kazakhstan, based on determining the weighted average value, taking into account the significance of each group of indicators. The final assessment is given according to the created scale of integrated assessment of food security. Three groups of indicators are used: food availability, availability and sufficiency of food consumption, quality and safety. The research results showed that the state of food security of the Republic of Kazakhstan during the examined period is assessed as insufficient, mainly due to a decrease in the availability of food and insufficient use of the resource potential of the agricultural sector. The study concluded that when solving practical problems, the methods for assessing food security do not allow researchers consider important characteristics of each country and use them for decision-making. It is necessary to further develop the methodological foundations for creating tools for measuring, evaluating and regulating the processes of interaction between the EAEU member states. The material is addressed to employees of state and municipal government bodies, economic educational institutions and the scientific community.

Keywords: food security, assessment of integration processes, agricultural sector, economic security, assessment of food security, food

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ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

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Развитие аграрного сектора как фактор обеспечения продовольственной безопасности Казахстана в рамках ЕАЭС

В рамках интеграционных объединений первоочередная цель каждого государства — обеспечить свою продовольственную безопасность, поэтому экономически целесообразно развивать аграрный сектор национальной экономики. В настоящей статье рассмотрена продовольственная безопасность Республики Казахстан в контексте интеграции членов Евразийского экономического союза. В исследовании предлагается методика расчета интегрального показателя продовольственной безопасности Казахстана, основанная на определении средневзвешенного значения с учетом значимости каждой группы показателей. Итоговая оценка проводится по разработанной авторами шкале комплексной оценки продовольственной безопасности. Проанализированы три группы показателей: наличие продуктов питания, доступность и достаточность потребления продуктов, качество и безопасность. Результаты исследования показали, что состояние продовольственной безопасности Республики Казахстан в рассматриваемый период оценивается как неудовлетворительное, в основном из-за снижения обеспеченности продовольствием и недостаточного использования ресурсного потенциала аграрного сектора. Сделан вывод, что методы оценки продовольственной безопасности не позволяют учитывать важные характеристики каждой страны и использовать их для принятия практических решений. Дальнейшее совершенствование методологии позволит создать инструменты для измерения, оценки и регулирования процессов взаимодействия государств — членов ЕАЭС. Результаты исследования предназначены для работников органов государственного и муниципального управления, учебных заведений экономического профиля, а также научного сообщества ы целом.

Ключевые слова: продовольственная безопасность, оценка интеграционных процессов, аграрный сектор, экономическая безопасность, оценка продовольственной безопасности, продовольствие

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Introduction

The main task of any integrated association is to solve various world problems and provide a unified response to external threats and challenges. One of these problems that have arisen in the world economy is ensuring food security of the state, based on the development of the agricultural sector of the national economy.

The purpose of this research is to study the state and trends in the development of the agricultural sector of the economy to ensure food security of the member of the Eurasian Economic Union (EAEU), to develop relevant assessment and indicators. In particular, they can be used for measuring and evaluating food availability, and sufficiency of food consumption, quality, and safety, the resource potential of the agricultural industry. The achievement of the goal will provide an opportunity to solve new scientific and methodological issues to clarify the theoretical basis for measuring food security parameters, methods and tools for assessing the state and trends in the development of the agricultural economy, considering the state depending on the levels: individual, household, national, regional and global.

As a result, the study presents tools that can be used to solve new scientific and methodological tasks, assess the processes of ensuring food security, and examine the state and trends in the development of the agricultural economy of Kazakhstan in the context of integration of members of the Eurasian Economic Union at the global, national, regional levels.

In particular, the study makes the following important contributions:

1. Presents systematic approaches to the definition of economic security. The complexity and dynamism of this phenomenon is caused by many economic, social, financial processes and globalisation that systematically and continuously impact the national economy, prompting the need to clarify certain aspects of the conceptual definition of economic security. Nowadays, in contrast to existing definitions, the definition should

include a set of internal and external conditions that contribute to the effective dynamic growth of the national economy, in which the system-forming condition is the security of an individual (citizen): provision of food, health services, education, housing, information, social protection, protection of all life support systems of society, the state and the person from various threats and losses.

This provision considers the achievement of the economic security of an individual as a system-forming factor since he is at the centre of dangers and risks. A particular person, first of all, suffers from any negative decisions implemented at the state level, as well as state policy in the areas of socio-economic, political, environmental, and other reforms. It is specified that the desired level of food security should not be lower than the minimum rational standards of consumption of basic food.

2. Describes the role of food security in the system of the national economic security, which is based on the priority needs. The most important task of the state is to ensure the population's physical access to good quality, safe food, as well as to create the economic conditions for food purchases.

The authors' definition of food security, in contrast to existing definitions, emphasises that food security is one of the main directions of ensuring the national economic security and constant economic and physical access of the population to good quality, safe food at a level not lower than the minimum rational standards of consumption of basic food, based on its food production at all levels (individual, household, regional, national).

3. Proposes a system of indicators for assessing food security in the Republic of Kazakhstan. It includes three main groups of indicators: food availability; availability and sufficiency of food consumption; quality and safety. The resource potential of the agricultural industry is considered as the most important condition. In accordance with the presented methodology of indicators for assessing food security, a method is proposed for calculating the integral indicator of food security in Kazakhstan, based on determining the weighted average value taking into account the significance of each group of indicators. The final assessment is given according to the created scale of integrated assessment of food security. In contrast to the existing methods, this method includes a system of conditions that guarantees a stable supply of all social groups of the population with the necessary food in the required amount during the year.

4. Presents a model for ensuring food security that allows tracking the occurrence of system failures, as well as deficiencies in the state's food system that lead to hunger or lack of food security. This model uncovers points of vulnerability in the existing food system of the state, including resources, producers, consumers, nutrition system, and consequences for public health, demonstrating what processes in this system can reduce risks or threats to food security.

The model helps to detect systemic and individual barriers to develop the state's efforts through various methods and regulatory tools in order to reduce hunger and increase food security, showing the relationship between nutrition and public health.

5. Considers the possibility of applying the organisational model of South Korea, based on structural solutions by creating a single state body responsible for food and drug safety under the Government of the Republic of Kazakhstan. The novelty of this decision is because the country does not have a single state body that provides security in this area. The existing mechanism is related to the functioning of a variety of government bodies, as well as non-governmental and interstate organisations operating on the territory of the Republic. At the same time, the activities of these authorities often duplicate the functions, and, in some cases, mutually cancel each other out in ensuring the safety of the population.

Theoretical Basis

In the scientific literature, the term "Food security" has appeared relatively recently and is considered a new economic category. The term "Food security" is translated from English in two ways and refers to food safety and food supportability.

The UN first recognised food as a universal human right in the 1948 Declaration of human rights, which established the evolution of concepts such as food security and public food security. International development in the 1960s first defined food security as the ability to meet aggregate food needs. Subsequently, international food security became a way to describe and measure the UN mandate to protect human rights to food and promote world trade[1].

In 2009, Food and Agriculture Organisation (FAO) stated that "Food security exists when all people at all times have physical, social and eco-

[1] United Nations Universal Declaration of Human Rights 1948. Organization of a United Nations Postal Administration [1948] UNGA 1; A/RES/232 (III) (8 October 1948). Retrieved from: http://www.worldlii .org/int/ other/ UNGA/1948. (Date of access: 04.02.2019).

nomic access to sufficient, safe and nutritious food to meet dietary needs and food preferences for an active and healthy life"[1].

Factors that affect food security vary by level, i. e. from global to regional and national, to domestic and individual. Food security is a multidimensional phenomenon encompassing climate change, civil conflict, natural disasters, and social norms, starting with the world food crisis of 1972–1974 and the food price shock of 2006–2008. The lack of food security required close attention from the state due to mass starvation and malnutrition of people[2].

These factors were studied by different authors for different countries, including Ethiopia (Gezimu, 2012; Ayalneh, 2012), Ghana (Owusu, Abdulai, Abdul-Rahman, 2011), Zimbabwe (Mango et al., 2014), Kenya (Kassie, Ndiritu, 2014), Brazil (Felker-Kantor, Wood, 2012) and Nigeria (Arene, Anyaeji, 2010), Pakistan (Abdullah et al., 2017), the Amhara region-Ethiopia (Aragie, Genanu, 2017), Mexico (Shamah-Levy et al., 2017), India (Debnath et al., 2017), China (Chavas, 2017), Bangladesh (Zhang et al., 2018), Georgia (Meskhia, 2016), and others.

Some researchers have attempted to define and re-interpret the concept of "Food security". Here are some of them.

Biryukov (2001) states that food security as an economic category determines the sustainable development of the economic system, the target parameters of its functioning and includes a subsystem of economic categories that characterise food independence, the level of regional food supply, economic and physical availability of food for the country's citizens, the quality and environmental cleanliness of food.

Eszhanova (2009) under food security understands the degree of provision of citizens of the state with environmentally friendly, healthy food products of their production, while their compliance with science-based standards must be observed; such food must be sold at affordable prices.

Conway and Barbier (1990) believe that, to ensure food security, at any time the entire population should be guaranteed access to food in the amount necessary to lead an active healthy life.

Russian scientist Altukhov (2010) considers it as the country's ability to meet the need for food at a level that guarantees the normal life of citizens.

Leshchilovskiy understands food security as the relationship between supply and demand, and the supply refers to the scientifically-based characteristics of food, while the demand is related to medical nutrition standards. Food security is a kind of balance between them, the state of the national economy (Leshchilovskiy, Gusakov, Kiveysha, 2007).

Balabanov and Borisenko (2002) see this phenomenon as the degree of national food production, which implements the principle of self-sufficiency of the country's citizens with basic types of food and the formation of state reserves following science-based standards.

Antamoshkina (2013) defines food security as the state of the national economy and agriculture, in which, regardless of the impact of different internal and external conditions, the needs of the population in food products are fully met according to consumption standards.

Safin (2013) also understands it as a complex of socio-economic relationships that arise over the provision of food to the population that meets the standards, both in quality and in quantity, based on the innovative formation of agricultural reproduction and ensuring economic security of the agricultural sector.

Russian authors Kudryashova and Presnyakova (2005) define food security as guaranteed satisfaction of food needs (including current consumption and creation of reserves) with the safety of produced food.

Serova (1996) interprets it as the level of food availability for the main part of the state's citizens to maintain a normal standard of living.

Chernova and Stepanenko (2006) define food security as the provision of vital food from their sources and their availability to the entire population of the state in the amount and range that best meet the required and useful needs.

Zhanbekova (2003) understands food security as a category that expresses the relationship between the state and its population regarding the issue of creating conditions to meet the needs of people in food according to their physiological norms.

Bimendieva (2002) and Kuzembaev (1997) see food safety understands the concept of economic, organisational, technological, social and environmental factors, aimed at sustainable functioning of the agricultural industry to meet the demand of citizens in various good quality food, the forma-

[1] Harvesting agriculture's multiple benefits: Mitigation, Adaptation, Development and Food Security. Retrieved from: ftp://ftp.fao.org/docrep/FAO/012/ak914e /ak914e00.pdf (Date of access: 18.02.2019).

[2] FAO. (2017). The state of food security and nutrition in the world 2017. Building resilience for peace and food security. FAO. Rome, 32.

tion of the necessary insurance reserves and export of surplus food.

Sultanbekova interprets food security of the state as the uninterrupted provision of citizens with quality food, mainly at the expense of food produced by domestic producers at the level necessary to preserve the life and health of citizens (Sultanbekova et al., 2001).

Thus, some of the authors understand food security as the food independence of the state (Biryukov, 2011), while others understand the availability of food (Conway, Barbier, 1990; Serova, 1996; Chernova, Stepanenko, 2006); some authors emphasise the safety of food (Kudryashova, Presnyakova, 2005; Eszhanova, 2009), and others highlight the special role of the agricultural industry (Antamoshkina, 2013; Safin, 2013; Bimendieva, 2002; Kazembaev, 1997).

We agree with the opinion of the authors, who focus on the development of the agricultural sector as the main factor of food security, since domestic food production and satisfaction of domestic demand at its on the development depend on the resource potential.

Methods and data

Primarily, methodological fundamentals of the established international practice are considered. There is a specialised institute of the United Nations Organisation (FAO), which unites the efforts of the global community towards ensuring food security of the residents of the planet, ensuring guarantees of regular access of the residents to high-quality food. Studies conducted in the UN present the methodological fundamentals of measurements, assessments and regulatory processes in food production[1].

The Global Food Security Index (GFSI) is used to assess the level of food supply of residents of different states and territories. This indicator is the result of a study by The Economist Intelligence Unit British analytical agency with the support of DuPont American transnational company, which helped to compile an annual rating of the states[2].

According to the GFSI index, Kazakhstan was on 57th place in 2014 with the 53.3 index, in 2015 and 2016 — on 56th place out of 109 countries with 56.8 index, in 2018 — on 57th place with 57.7 index. It can be concluded that the positive dynamics of this indicator within the last 5 years is not evidenced.

Table 1 presents the comparative analysis of the methodology of FAO food security assessment and the system of its indicators used in the Republic of Kazakhstan.

The analysis of Table 1 shows that, according to the methodological aspect, Kazakhstan follows the FAO regulations in most indicators.

Significant work on coordination is provided under the interaction of the EAEU states participants. In the system of indicators accepted in the EAEU states community along with others, the followings are used: the level of self-sufficiency in basic agricultural products[3], as a percentage of medical consumption standards[4] (Table 2 and Table 3) and staple food consumption by the EAEU states residents, kg annually (Altukhov, 2010; Antamoshkina, 2013). The data in these Tables show that for a number of positions (milk, meat, fruits, sugar) the state has lagged behind medical standards and consumption volumes by type of product in the EAEU member countries

As an essential reserve for ensuring food security is the ability to regulate the volumes of mutual trade.

The Concept of food security of the Eurasian Economic Union member states was adopted. The Eurasian Economic Commission develops and publishes on the official website the joint forecasts of the EAEU member states concerning the development of agricultural industry for the main types of agricultural products and food in order to increase mutual trade[5].

While solving practical tasks, the methods of food security assessment do not allow considering important characteristics of each state and use them to make decisions. Actions are required for

[1] The Food and Agriculture Organisation of the UN (FAO). Retrieved from: http://www.fao.org (Date of access: 15.01.2018).

[2] The Global Food Security Index: official website. Retrieved from: http://foodsecurityindex.eiu.com (Date of access: 15.01.2018).

[3] Eurasian economic Commission. Concept of collective food security of the member States of the Eurasian economic Union (draft). Moscow, Russia. Retrieved from: http://www.eurasiancommission.org/ru/act/prom_i_agroprom/dep_agroprom/agroprom/Documents/%D0%BF%D1%80%D0%BE%D0%B5%D0%BA%D1%82%20%D0%9A%D0%BE%D0%BD%D1%86%D0%B5%D0%BF%D1%86%D0%B8%D0%B8%20%D0%BF%D1%80%D0%BE%D0%B4%D0%B1%D0%B5%D0%B7.pdf (Date access: 23.12.2019).

[4] On joint forecasts of the development of the agricultural industry, supply and demand of the member States of the Eurasian Economic Union for the main types of agricultural products and food for 2016–2017. Eurasian Intergovernmental Council.-Order 07" March 2017, Bishkek.

[5] Russian Federation government. (2018). Resolution of the Government of the Russian Federation "On extending the zero rate of export customs duty on wheat" (June 27, 2018 No 737). Moscow, Russia. Retrieved from: http://government.ru/docs/33042/ (Date of access: 24.12.2019). Retrieved from: https://ecfs.msu.ru/index.php/ru/news/300-doctrina (Date of access: 22.01.2020).

Table 1

Comparative analysis of the methodology of FAO UN food security assessment and the Republic of Kazakhstan

№	FAO UN	the Republic of Kazakhstan
1	*Indicators of occurrence*	
1.1	Dietary Average Nutrition Adequacy	The proportion of energy value of nutrition from the average required energy value of nutrition, %
1.2	Food production index	Socially Important Food Product Price Index
1.3	The share of energy derived from cereals, root crops, tuber crops	The share of the energy value of nutrition derived from cereals, root crops and tuber crops in the total energy value of nutrition, %
1.4	Average protein in food	Average protein consumption, gram/person a day
1.5	Average protein content of animal origin	Average protein content of animal origin, gram/person a day
2	*Indicators of physical availability*	
2.1	The percentage of paved roads relative to the total length of roads	The share of the length of roads with paved roads from total length of roads, %
2.2	Railway density	Railway density per 100 square kilometres
2.3	Road density	Road density per 100 square kilometres
3	*Indicators of economic availability*	
3.1	CPI for food	Domestic Food Price Index
4	*Usage indicators*	
4.1	Access to improved water sources	Access to improved water sources, % by residents
4.2	Access to improved sanitary systems	Access to improved sanitary-technical systems, % by population
5	*Indicators of insufficient access to food*	
5.1	The extent of malnutrition	The share of residents in the risk zone of malnutrition (starvation) by residents, %
5.2	The share of food expenditures of the poor	The share of food expenditures of the poorest part of residents, %
5.3	The level of food deficiency	Uneven food distribution per capita, kcal/person per day
5.4	The spreading of food deficiency	Lack of nutrition for certain part of residents that does not have a normal level of food consumption, normalised by total residents, kcal/person per day
6	*Stability indicators*	
6.1	Internal food volatility	Internal food volatility on food
6.2	Food production per capita	Mean value of food production per capita
6.3	Food consumption per capita	Internal consumption
6.4	Political stability and absence of harassment and terrorism	Index of political stability and absence of harassment and terrorism
6.5	The share of food import in total product export	The relation of the cost of food import to total volume of the cost of export of all products, %
6.6	Percentage of irrigated arable land	The share of arable land suitable for irrigation of the total area of arable land
6.7	The coefficient of dependence on grain imports	The share of grain import in total volume of grain available in the market, %
6.8	—	The volume of purchases of food in regional stabilisation funds, tonnes

Table 2

Self-sufficiency of residents of the EAEU member states by main types of food, % 2017

Products	Armenia	Belarus	Kazakhstan	Kyrgyzstan	Russia
Grain	40.7	89.8	148.5	62.3	170.6
Milk	91.2	235.4	90.3	105.7	82.0
Meat	67.7	135.9	81.2	62.5	93.3
Potato	102.6	112.3	99.1	110.0	92.7
Vegetables and cucurbitaceous	102.5	105.5	127.8	146.8	87.5
Fruits and berries	108.5	43.5	25.1	20.7	33.1
Sugar	65.2	224.3	64.8	63.0	98.8
Vegetable oil	4.3	74.0	85.0	19.6	…
Fish	101.8	13.9	…	4.0	…
Eggs	98.2	128.8	106.3	41.5	…

Table 3

Consumption of the main types of food by residents of the EAEU member states, kg a year*

Product kg per year	Armenia		Belarus		Kazakhstan		Kyrgyzstan		Russia	
	kg per year	% of standard	kg per year	% of standard	kg per year	% of standard	kg per year	% of standard	kg per year	% of standard
Bakery	175.8	135.5	133.7	139.3	133.7	139.3	127.7	110.7	117.0	121.9
Milk and dairy products	262.1	78.0	237.7	79.0	237.7	79.0	223.3	111.7	231.0	71.1
Meat and meat products	57.1	156.4	72.9	93.0	72.9	93.0	38.5	62.8	75.0	102.7
Fish and fish products	5.6	50.9	10.7	76.4	10.7	76.4	0.9	9.9	19.6	89.1
Vegetable oil	9.8	134.2	19.5	162.5	19.5	162.5	10.3	112.8	13.9	115.8
Eggs	237.2	130.0	168.5	63.6	168.5	63.6	86.0	47.1	279.0	107.3
Potato	67.6	74.0	46.9	46.9	46.9	46.9	106.6	108.2	90.0	100.0
Vegetables and cucurbitaceous	211.1	192.8	88.5	59.4	88.5	59.4	174.4	152.6	103.0	73.6
Fruits and berries	106.6	146.0	64.6	48.9	64.6	48.9	34.2	27.6	59.0	59.0
Sugar	22.6	123.5	41.3	125.2	41.3	125.2	22.8	89.2	39.0	162.5

further development of methodological fundamentals of creating tools for the measurement, assessment and regulation processes of interaction with the EAEU member states. Currently, the number of reasons prevent deepening interaction, such as:

1. In some cases, there is no opportunity to get a full and reliable base of statistical data on indicators. For instance, the Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan has developed the system of indicators designed for monitoring the conditions of food security of the state. However, these indicators, such as Variability of Food Supply per capita (kcal/person a day) and Domestic Food Price Index are not provided by responsible State represented by the Ministry of Agriculture of the Republic of Kazakhstan. The Ministry of National Economy of the Republic of Kazakhstan does do not present the share of the energy value of nutrition from the average required energy value of nutrition and Average protein intake (grams/person per day), as well as several other indicators.

2. Not every obtained integrated indicator can be interpreted and used for the analysis of the food security status of the current period and used as a forecasting base for future periods.

3. Discovered indicators of food security do not allow researchers to reveal more significant risks and threats and to use them while developing the mechanisms and instruments to improve the food situation of the state.

Thus, as a result of the analysis and generalisation of studies presented by local and foreign scientists, in this work we propose the conditions system required for the assessment of food security and food independence of the state. It should reflect conditions that guarantee the stable provision of all social groups of residents with staple food in necessary amount throughout a year. At the same time, their average per capita food consumption should meet scientifically proven medical standards by the recommendations of the UN specialised agency — the World Health Organisation (hereinafter — WHO).

Table 4 presents the system of indicators for assessing food security of the Republic of Kazakhstan, which is divided into 4 main groups:

1) Food availability indicators;

2) Indicators of availability and sufficiency of food consumption;

3) Quality and security indicators;

4) Resource potential of the agricultural industry.

The calculation of the integrated indicator of food security of the Republic of Kazakhstan is based on determining an average weighted value taking into account the significance of each group of indicators according to the formula (1):

$$FS_i = \sum_{i=1}^{n} w_i \cdot FS_i^j, \quad (1)$$

where FS_i — i-particular efficiency coefficient; FS_i^j — i-particular efficiency coefficient; w_i — i-weight coefficient that determines the level of significance of particular efficiency coefficient; n — the number of the indicators group, $i = \overline{1.4}$; j — the number of years.

Significance (weightage) indicator w_i of each group of indicators is calculated under the method of expert assessment by the formula (2):

Table 4

The system of indicators of the assessment of food security of the Republic of Kazakhstan

No.	Indicators
1	Food availability indicators
1.1	Financial affordability of food
1.1.1	Gross domestic product per capita (in equivalent of spending capacity)
1.1.2	Coefficient of consumption expenditures
1.1.3	Coefficient of financial affordability of food for employed residents
1.1.4	Coefficient of financial affordability of food for pensioners
1.1.5	Relative share in cash expenditures average per capita on food per month
1.2	Economic affordability of food
1.2.1	Poverty coefficient
1.2.2	Coefficient of spending capacity of residents income
1.2.3	Gini coefficient of incomes concentration
1.2.4	Coefficient of economic affordability of food
1.3	Physical accessibility of food
1.3.1	The share of the length of paved roads of total length of roads, as a percentage of all roads
1.3.2	Road density per 100 sq. km of area
1.3.3	Railway density per 100 sq. km of area
2	Indicators of availability and sufficiency of food consumption
2.1	Self-sufficiency in food
2.2	Dependency from food import
2.3	The level of food deprivation
2.4	Food consumption satisfaction
2.5	Commodity stocks in retail environments (bln tenge, per trading day)
2.6	Procurement of food products in stabilisation funds
3	Indicators of quality and security
3.1	Access to better water sources, % from the residents number
3.2	Ecological purity of product
3.3	Sufficiency (caloric value) of nutrition
4	Resource potential of the agricultural industry
4.1	Financial resources
4.2	Land resources
4.3	Labour resources
4.4	Fixed capital investment in food production
4.5	Labour productivity in agriculture
4.6	Innovative activity of agricultural enterprises
4.7	Production of agricultural products (services)
4.8	Livestock productivity
4.9	Crop productivity
4.10	Production of agricultural products
4.10.1	Food production
4.10.2	Beverage production

$$w_i = \frac{R_i}{S_R}, \quad (2)$$

where i ($i = \overline{1, N}$) — the direction of activity of the subject of the economy; R_i — significance rank of examined i-st group of indicators (the most significant is given maximum N value, the least significant — minimum N value); S_R — the sum of all significant rank values.

Table 5 presents the weightage coefficients of an integrated assessment of food security.

To calculate the effectiveness of each group of indicators, we use the geometric mean since it gives the best estimate of the degree of change in time series according to the formula (3):

$$FS = \sqrt{\prod_{i=1}^{n} FS_i}, \quad (3)$$

where FS — the indicator of total integrated assessment of food security.

Integrated assessment of food security uses a system of economic indicators that have a va-

Table 5

The weightage coefficients of integrated assessment of food security

No.	Criteria name	Importance rank	Weightage coefficient
1	Food availability indicator	3	0.3
2	Indicators of availability and sufficiency of food consumption	2	0.2
3	Indicators of quality and security	1	0.1
4	Resource potential of the agricultural industry	4	0.4
	Sum	10	1.0

Source: Developed by the authors.

riety of units of measurement. In order to compare them with each other, it is necessary to convert them into dimensionless units on a unit scale from 0 to 1, i. e. to the entire data set should be associated with a unit interval [0, 1] according to the formula (4):

$$x_i^{norm} = \frac{2x_i - (x_i^{\max} + x_i^{\min})}{x_i^{\max} - x_i^{\min}}, \quad (4)$$

where x_i^{norm} — normalised economic indicators; x_i — initial economic indicators; $x_i^{\max}$ — maximal economic indicators; $x_i^{\min}$ — minimal economic indicators.

If we calculate using this formula a generalised integral indicator without dimension located in the range from 0 to 1.0, then we can translate a quantitative assessment into a qualitative one, derived linguistically.

For final food security assessment, we developed a scale of private indicators for each group of indicators, the values of which are presented in Table 6.

The information base for calculating the proposed system of indicators is statistical data of some state bodies of the Republic of Kazakhstan, which is related to the food supply of the residents of a state, and the Committee of the Ministry of National Economy of the Republic of Kazakhstan, documents of the Government of economic departments and the Government of Russia[1].

Results and Discussions

The proposed methodology was implemented to assess the food security of the Republic of Kazakhstan for the period 2010–2018.

Obtained indicators are included in logical sequence in the model, and converted to dimensionless scale to realise the integrated assessment of food security of the Republic of Kazakhstan. The calculation of availability indicators showed that the share of per capita monetary expenditures per

Table 6

Scale of integrated assessment of food security

No.	Qualitative assessment of indicator level	Quantitative assessment of indicator level
1	Sufficient level	$0.90 \le FS \le 1.0$
2	Minimum required level	$0.05 \le FS < 0.90$
3	Insufficient level	$0.20 \le FS < 0.50$
4	Critical level	$0.01 \le FS < 0.20$

month on food in Kazakhstan is about 40.4 % on average over the period, which is typical for countries with transition economies. The financial availability of food remains insufficient during the study period in Kazakhstan.

The share of food expenditures in the average per capita monthly monetary expenditures for 2010–2018 is 0.4, i. e. in the budget of Kazakhstan, food expenditures make up more than 40 %. This situation is caused by low incomes and high prices for food products. The coefficients for assessing the economic availability of food, in general, have an acceptable level, indicating that the majority of the population does not have problems with nutrition and does not experience hunger. The analysis of the physical availability of food showed that its level is quite high due to the successful implementation of the state programme of infrastructure development "Nurly Zhol" for 2015–2019. Its strategic goal is to ensure the integration of the country's transport infrastructure into the international transport system. However, despite the implementation of several state programmes for the development of the agricultural sector, the country still has a high share of imported food. This is especially true for such products as fruits and vegetables due to the objective climatic and geographical conditions in the country. Indicators of the level of food deprivation in Kazakhstan are uneven and, based on the data, it can be concluded that the problem of hunger is not relevant for Kazakhstan, but Kazakhstan is a country with a very low level of food deprivation. The analysis of the coefficients meet the average needs of the main kinds of products in the Republic of Kazakhstan 2010–2018, allowing us to conclude that only the potato and its

[1] Decree of the President of the Russian Federation (2020) "On approval of the food security Doctrine of the Russian Federation" (January 21, 2020 No 20). Moscow, Russia. Retrieved from: http://publication.pravo.gov.ru/Document/View/00012 02001210021 (Date of access: 23.01.2020).

Table 7

Key indicators of the agricultural industry of Kazakhstan, billion tenge

Indicators	the year 2010	the year 2012	the year 2014	the year 2016	the year 2018
Gross output of agricultural products (services), billion tenge, including	1822.1	2393.6	3143.7	3684.4	4474.1
plant growing	895.4	1241.5	1739.4	2047.6	2411.5
livestock farming	920.8	1145.4	1393.8	1621.5	2050.5
food production	695.2	865.6	1103.5	1448.4	1527.7
beverage industry	149.7	182.0	233.1	254.3	343.8
Labour productivity per person employed in agriculture, thousand tenge	428.8	410.9	1070.1	1401.9	2076.6
Volume of fixed capital investment in the manufacturing industry	413.1	610.7	728.6	877.9	1 247.2
Fixed capital investment in food production, billion tenge	41.64	34.58	38.55	63.43	111.80
Profitability (loss) of agricultural production, %	17.9	24.8	28.2	36.1	40.3
Profitability of crop production, %	19.1	29.7	35.3	46.6	39.8
Profitability of livestock production, %	15.2	14.3	16.6	16.8	17.2

by-products, meat and meat products fully meet the average needs.

The results of the calculation of quality and safety indicators show that the share of investments directed to the "Green economy" in the field of agriculture, forestry, and fisheries is negligible and does not even reach 1 %. Mechanisms for environmental labelling with the "ECO" sign are being developed to stimulate the development of this direction that contributes to the formation of a market for natural and environmentally safe products of the highest quality, and the promotion of the introduction of the best existing technologies for the production of such products.

It can be concluded that in Kazakhstan, with a high value of the coefficient of variation (about 30), the uneven distribution of energy among the population is primarily due to income (or expenditure) based on the analysis of the coefficient of variation of the energy value of food consumed-DEC. However, the indicator does not tend to significantly decrease. At a low value (about 20), the unevenness is mostly due to biological factors.

The analysis of the proposed indicators of resource potential of agribusiness suggests that the government allocates significant financial resources for the development of the agrarian sector. The state support provided to the agricultural industry in general and agriculture in particular is implemented through such instruments as subsidies, financial leasing, loan guarantees and interest rates on them. The state guarantees up to 7 % per annum in domestic and 5 % in foreign currency.

The regression equation for the dependence of food production on investment in fixed assets of agriculture has the following form (Table 7):

$$\gamma = 8{,}225\chi + 628{,}6.$$

An increase in fixed capital investment by 1 unit leads to an increase in food production by 8,225 units, i. e. it has a high sensitivity. At the same time, the correlation coefficient $r = 0{,}86$ indicates a strong influence of fixed capital investment in agriculture on the growth of food production. The coefficient of determination indicates the high quality of the constructed mathematical model $R^2 = 0{,}732$.

Table 8 shows that the productivity of livestock and poultry in Kazakhstan for 10 years shows an increasing trend in comparison with 2010, but when compared with 2017, there is a decrease in productivity indicators, cattle, pigs, sheep and goats, poultry, and shearing wool from one sheep. Productivity does not decrease for the following groups: average milk yield per milch cow, average egg yield per laying hen. The calculated correlation coefficient is equal, $r = 0{,}85$, i. e. there is a fairly close direct relationship between these two indicators.

The yield of cereals (including rice) and legumes has been increasing steadily since 2012, while the acreage of cereals (including rice) and legumes in Kazakhstan in the period 2010–2018 has been decreasing steadily since 2010 every year (Table 9).

In the period 2010–2018, the updated acreage of agricultural crops in Kazakhstan was growing for the following crops: cereals (including rice) and legumes, cotton, potatoes. There is a decrease in the sown area for the following crops: oilseeds, vegetables, cucurbits crop, and forage crops.

If the total acreage occupied by the crop is considered, it decreases during the study period. Compared to 2010, with an area of 21271.0 thou-

Table 8

Productivity of livestock and poultry in agriculture of the Republic of Kazakhstan for 2010–2018

Indicators	the year 2010	the year 2012	the year 2014	the year 2016	the year 2018
Average live weight of cattle, kg	299	310	319.5	330.3	333.2
Average live weight of pigs, kg	94	98	103	107.6	106.2
Average live weight of sheep and goats, kg	37	38	38.5	39.3	39.1
Average live weight of poultry, kg	1.9	2.1	2.3	2.5	2.2
Average milk yield per milch cow, l	2255	2219	2262	2278.6	2340.6
Average yield of eggs per laying hen, pieces	215	213	219	221.8	246.4
Average shearing of wool per sheep, kg	2.8	2.4	2.2	1.94	2.4
Average live weight of cattle, kg	100	103.0	101.8	101.7	99.3
Average live weight of pigs, kg	100	102.1	102.0	102.2	96.6
Average live weight of sheep and goats, kg	100	102.7	101.3	101.0	98.5
Average live weight of poultry, kg	100	105.0	104.5	104.2	84.6
Average milk yield per milch cow, l	100	100.4	99.2	100.4	102.3
Average yield of eggs per laying hen, pieces	100	99.5	99.5	100.6	110.4
Average shearing of wool per sheep, kg	100	96.0	91.7	93.7	132.6

Table 9

Productivity of the main types of crops in agriculture of the Republic of Kazakhstan for 2010–2018, hundredweight per hectare

Cultures	the year 2010	the year 2012	the year 2014	the year 2016	the year 2018
Cereals (including rice) and legumes	8.0	8.6	11.7	13.5	13.5
Oil crop	5.0	6.1	7.8	9.6	12.6
of them sunflower	4.4	5.9	6.7	9.3	10.0
Potato	143.0	165.9	184.3	190.4	197.9
Open ground vegetables	214.4	234.0	243.0	250.0	257.3
Cucurbits crop	177.0	206.8	217.1	221.4	224.2
Sugar beet	174.3	168.2	240.6	285.5	305.3
Cotton	17.9	26.2	25.1	26.2	25.9
Cereals (including rice) and legumes	100.0	50.9	100.9	106.3	100.7
Oil crop	100.0	91.0	97.5	118.5	113.5
of them sunflower	100.0	128.3	95.7	122.4	98.0
Potato	100.0	99.2	101.5	102.6	101.9
Open ground vegetables	100.0	105.0	101.8	101.7	101.4
Cucurbits crop	100.0	111.1	102.2	100.2	100.0
Sugar beet	100.0	89.4	89.9	122.8	111.3
Cotton	100.0	120.2	87.5	94.2	106.1

sand hectares in 2018, it amounted to 21 190.7 thousand hectares, showing a decrease of 80.3 thousand hectares or 0.5 %.

The found correlation coefficient indicates the average inverse effect on the yield of grain growth of their sown area $r = –0,42$.

The share of loans to Agriculture in the total volume of loans to the economy does not exceed 5.5 %, and for agribusiness entities no more than 11 %.

State support for agriculture in the form of a financial subsidy has a significant impact on the volume of agricultural products (services). However, despite the overall growth in the volume of lending to Agriculture in the period 2010–2016, starting from 2017, it was sharply reduced for agribusiness entities as a whole. If the volume of lending to the economy as a whole and Agriculture tends to grow steadily, lending to agribusiness entities is uneven. Such failures are especially strong after the devaluation of tenge in 2014, and the growth is associated with the implementation of the agribusiness development programme in 2017–2021.

It is impossible to introduce innovative technologies in the agricultural sector of the state economy without proper funding from the state and banks of agribusiness entities. In the conditions of limited resource potential of the agricultural sector, the tasks of increasing sustainability and the volume of agricultural production can only be implemented on an innovative basis. Extensive introduction of innovations, the use of

Table 10

Integrated assessment of food security of the Republic of Kazakhstan for 2010–2018

#	Indicator	2010	2012	2014	2016	2018
1	Food availability indicators	1.30	1.209	0.119	0.000	0.000
2	Indicators of availability and sufficiency of food consumption	0.02	0.04	0.06	1.66	0.870
3	Quality and safety indicators	0.00	0.56	0.81	0.68	0.85
4	Resource potential of the agro-industrial complex	0.07	0.00	0.20	0.40	0.00
	FS_i	0.04	0.42	0.20	0.56	0.09
	Integral estimation	0,37		Insufficient level		

resource-saving technologies, and the implementation of innovative activities guarantee the stable development of the agricultural sector. It is necessary to develop reliable sources of investment funds to introduce innovative technologies in the agricultural sector of the economy, and this is possible by increasing the availability of loans for the agricultural sector.

An analysis of the dynamics of the employed population and the average monthly nominal wage in the Agriculture, forestry and fishery industry allows us to conclude that there is a strong inverse relationship between these two indicators with a correlation coefficient equal to, which leads to the conclusion that the $r = –0,97$ industry is unattractive in financial terms. This state of affairs can be considered a threat to food security since the outflow of labour resources from the industry can lead to a shortage of personnel and production reduction.

A correlation coefficient between the number of skilled workers showed a clear downward trend and the average monthly nominal wage in the Agriculture, forestry and fisheries sector $r = –0,94$. The outflow of qualified workers from the industry is also a strong threat to food security since without such personnel it is impossible to ensure the innovative development of the agro-industrial complex.

Based on all calculations and the weight coefficients, as well as the Scale of integrated assessment of food security, the following results were obtained and presented in Table 10.

Therefore, the state of food security of the Republic of Kazakhstan for the period 2010–2018 can be assessed as insufficient. Mainly, a decrease in the availability of food is not applicable to the full resource potential of the agricultural sector of the economy of Kazakhstan.

Conclusion

The primary task of increasing national food production is the necessity to achieve food and economic security of the country, meet the needs of citizens in food and increase the socio-economic efficiency of agriculture. The importance and role of the agricultural sector for food security is expressed in the resource provision of the food production process. The gap in the supply chain of resources from the agricultural producer and food producer to the final consumer leads to insufficient food security of the state as a whole, making it dependent on food imports. It is impossible to solve many primary and strategic problems without highly efficient and competitive agricultural production for the development of the country's economy and the formation of a civilised agri-food market. Therefore, until the agricultural sector of Kazakhstan receives sufficient investment to implement large-scale modernisation and reconstruction of agricultural production, the technical and technological gap will remain in the industry, therefore, the problem of increasing competitiveness will be particularly real. The state needs to continue actively supporting the development of the agricultural sector, while not violating the rules of the WTO, as well as develop programmes for targeted food assistance to socially vulnerable segments of the population.

In the further formation of the agricultural sector of the economy, the state should provide for the development of livestock industries based on the growth of its productivity, as well as crop production due to the increase in productivity of the main types of crops. In this regard, it would be necessary to increase the financing of innovative technologies of agricultural production. Innovative development of the agricultural sector in the current conditions is directly related to the implementation of promising investment projects, which is difficult to perform without state support. An important role in this direction should be given to state support for investment and innovation processes, development of national technology centres and technology parks, reduction of taxes and the inflationary component of costs, taking into account anti-crisis measures to improve the situation in the agricultural sector of the country.

Analysis of the development dynamics of processes in ensuring food security has allowed us to identify problems and "growth points" in the areas of possible regulation:

— in the field of ensuring the physical availability of food: achieving effective work of agriculture and processing industry; promoting the introduction of innovative technologies in the field of agriculture; creating institutions for the development of the agricultural market;

— in the context of overcoming the consequences of the pandemic: creating a system of domestic food aid based on the products of the agricultural industry. Directions of food aid include: targeted food aid to low-income segments of the population, social nutrition in budgetary institutions, etc. The amount of food sent to these areas reaches 18–20 % of the food consumed in the region/country;

— in the field of economic accessibility of food: reducing poverty; maintaining a stable level of income; organising social nutrition; regulating food prices; increasing the volume; reviewing the structure of the food basket; providing targeted food assistance; improving the quality of life in rural areas;

— in the field of food safety: eliminating natural and anthropogenic food pollutants; ensuring quality control of raw materials and products; promoting proper nutrition, healthy lifestyle; creating and certifying quality management systems; controlling the use of antibiotics, food additives in the food industry, fertilisers in crop production;

— in the institutional sphere: creating a structured and integral distribution management system; spreading a culture of safe food consumption; reducing health threats through national cooperation; providing accurate scientific annual information to the population; creating a system for responding to climate change and infectious diseases; developing a scientific and preventive safety management system; stimulating the production of environmentally safe food;

— in the field of environmental protection measures: encouraging landowners to use soil protection technologies; expanding the scale of organic farming; developing and testing of methods for measuring greenhouse gas emissions and uptake.

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