# ANALYSIS OF GRAIN PRODUCTION IN THE REPUBLIC OF KAZAKHSTAN AND PROSPECTS FOR ENSURING FOOD SECURITY

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*Abstract*

*The relevance of this study is due to the growing role of agriculture in the economic development of systems and the need to analyze and develop approaches to improving the efficiency of agriculture and ensuring food security of the each country. The object of this study is the grain production in Kazakhstan based on retrospective statistics and within the framework of the prospects for ensuring food security. To achieve this goal, the following methods were used: analysis, synthesis, comparison, historical and complex mathematical and statistical methods. The following can be cited as the main results of the study: at the end of 2022, Kazakhstan was not among the top ten leaders in the world's gross wheat harvest, possessing only 2% of the global figure, while it ranks 8th in exports with 3.4% of the world value. Retrospective dynamics of the gross grain harvest in Kazakhstan shows that until 1980 there was an increase in its levels, then a fall until 1998, which again changed to growth, but the levels reached during the Soviet period of development have not been exceeded at present. The main grain-producing regions are concentrated in the northern part of Kazakhstan, which is due to acceptable natural and climatic conditions and the presence of chernozems. Directions for modernizing Kazakhstan's agriculture are presented, which will ensure its food security.*

*Key words*: *agricultural economics, processing industry, grain cluster, gross harvest, forecast*

## INTRODUCTION

The relevance of this study is due to the growing role of agriculture in recent decades and the need to develop approaches to improving the efficiency of agriculture and ensuring food security at the level of all countries and regions. There are various national economies operating in the global economic space, which are constantly searching for their place in foreign trade relations. Trade flows of food products from and to a country are directly related to the issue of economic and food security [2; 12]. Cereals are very important for the sustenance of human populations and farm animals, grown for their important role in human diet, animal feed and biofuels [2; 4; 13].
Republic of Kazakhstan is no exception, which has significant weight in the post-Soviet space and makes a significant

contribution to the Eurasian Economic Union [1; 7; 8; 24]. The transformation of the former Soviet Union countries' economic models after more than 30 years has led to the formation of sustainable systems that successfully resist the influence of external shocks and steadily increase the production of various goods and services. Despite the successes achieved, the country's food security is of concern, since the natural and climatic conditions are not favorable for crop production, while the country's population is constantly growing (20% or 3.3 million people for the1990-2022 period). These trends necessitate the study of the state and prospects of the grain production for ensuring food security.
It is worth noting the works devoted the grain production in the Republic of Kazakhstan [9; 10; 15; 22; 25], which provide an assessment

of the effectiveness of this sector and identify its problems and prospects.

In turn, in our study, we will take into account the theoretical, methodological and practical developments of the presented authors. Evaluation of the identity of the results obtained by us and previously published studies by third-party authors will be carried out at the end of the article.

The object of this study is the grain production in Kazakhstan based on retrospective statistics and within the framework of the prospects for ensuring food security.

## MATERIALS AND METHODS

To conduct the study, time series of indicators from international official statistical sources were used [16, 17, 18, 19; 23]. Three-letter country designations correspond to ISO 3166-1.

The research methodology of the grain and food cluster study based on the theoretical and methodological approaches outlined in [11]. It consists of three stages:
- formation of hypotheses and collection of statistical material;
- assessment of Kazakhstan's place and role in the global grain production and export;
- assessment of the state and prospects of development of the livestock complex in Kazakhstan.

At each stage of the study, various methods of scientific research were used.

Such general scientific methods as historical, comparison, analysis and synthesis were used at stage 1. Analysis and synthesis were used at stage 2, as well as the comparison method. The place and role of Kazakhstan in the world production and export of wheat were identified. At stage 3, mathematical and statistical methods were used, tabular and graphical (visualization of initial information and analysis results), coefficient (reflection of the structure, dynamics and ratio of parts), and correlation-regression (identification and measurement of relationships) in particular.

Next, we will move on to the results of testing the proposed methodology for studying the

features of the functioning of the grain and food cluster of Kazakhstan.

## RESULTS AND DISCUSSIONS

At the first stage of the study, let's turn to the data of the Statistics Division United Nations and analyze the dynamics of the structural transformation of the economic system of Kazakhstan (Table 1).

Table 1. The change in the specific weights of the GVA of types of economic activity in Kazakhstan, in % of the total GVA of all types of economic activity

| Types of economic activity | 1990 | 1995 | 2000 | 2010 | 2020 | 2022 | 2022 compared to 1990 (+/-) |
|---|---|---|---|---|---|---|---|
| ISIC A-B | 31,8 | 12,9 | 8,6 | 4,6 | 5,7 | 5,7 | -26,1 |
| ISIC C-E | 13,7 | 23,9 | 34,6 | 34,0 | 28,6 | 32,0 | 18,3 |
| ISIC F | 10,6 | 6,3 | 5,5 | 7,96 | 6,4 | 14,5 | 3,9 |
| ISIC G-H | 8,0 | 18,8 | 13,8 | 14,3 | 19,3 | 5,7 | -2,3 |
| ISIC I | 8,8 | 11,1 | 12,3 | 11,5 | 9,7 | 18,8 | 10,1 |
| ISIC J-P | 27,2 | 27,0 | 25,3 | 27,6 | 30,3 | 8,8 | -18,4 |

Source: compiled on the data from [21; 23].
Types of economic activity are presented according to the ISIC classifier.

In Table 1, we are primarily interested in the value of the share of agriculture and the fishing industry (ISIC A-B). In 1990, this industry in Kazakhstan accounted for 31.8% of the total GVA of all industries, which did not correspond to the global state, since on average the share of this type of activity in developed countries did not exceed 5%. This situation is typical for all post-Soviet countries, it clearly shows the differences between a planned economy and a market economy, in which agriculture played a prominent role.

It is worth noting that because of the transformation of the economic system and the formation of market institutions, the share of agriculture decreased, and as of 2022 in Kazakhstan it amounted to 5.7% (a decrease of 26.1 percentage points) [21].

This trend is inherent in all post-Soviet countries, since in a market economy the service sector and manufacturing industry come to the forefront (the growth of the industrial sector in Kazakhstan for the period 1990-2022 amounted to 18.3 percent points).

Next, let's turn to the FAOSTAT data to assess the position of the post-Soviet countries (including Kazakhstan) in the world production of wheat (Fig. 1).
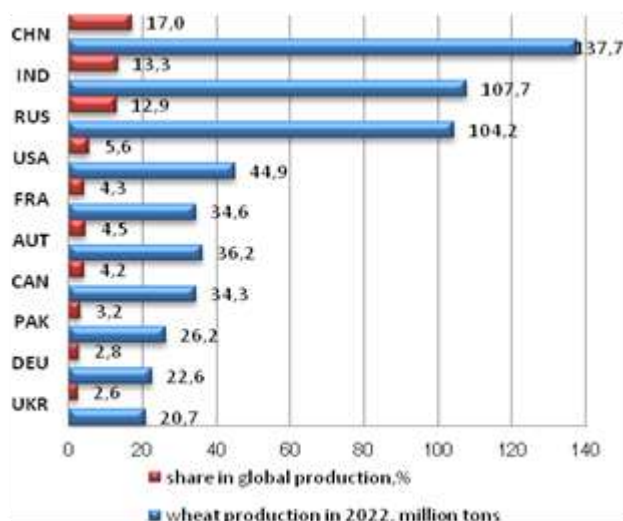


Fig. 1. TOP 10 countries in wheat production in 2022
Source: compiled on the data from [6].

According to the data shown in Figure 2, China occupies a leading position in wheat production, having produced 17.0% of the total world volume in 2022. India is in the second place with 13.3%. The leading placement of these countries is expected, since a significant part of the planet's population lives on their territory (in total, about 36% of the total population of the Earth). Accordingly, these states need to produce significant amounts of food (including grain) to ensure food security.

The Russian Federation is firmly entrenched in third place, but the reasons for the significant output in this case differ from the above countries. Russia produces grain for export, i.e. this direction is one of the key ones in the food export policy of this state.

The ten countries presented in Fig.1 in 2022 together produced about 70% of the total world volume.

In Kazakhstan, in 2022, 16.4 million tons of wheat were produced, which is 38.9% higher than the result of 2021, but at the same time, the volume of production in the reporting year amounted to only 2.03% of world production. Despite the insignificant value of the shares in wheat production, Kazakhstan occupies a significant place in the world production.

Obviously, wheat production will differ from its exports, so let's move on to the data shown in Fig. 2, which outlines the TOP 10 exporting countries of the product in question. According to the information given in Figure 3, the composition and positions of countries in terms of wheat exports differ from the values of the gross harvest. So, in the top three are Australia with 15.4% of all world wheat exports, USA with 11.2%, and France with 10.8%. As for Kazakhstan, at the end of 2022, the country ranks 8th in wheat exports, which is explained by the high values of the gross grain harvest (including wheat) that year.
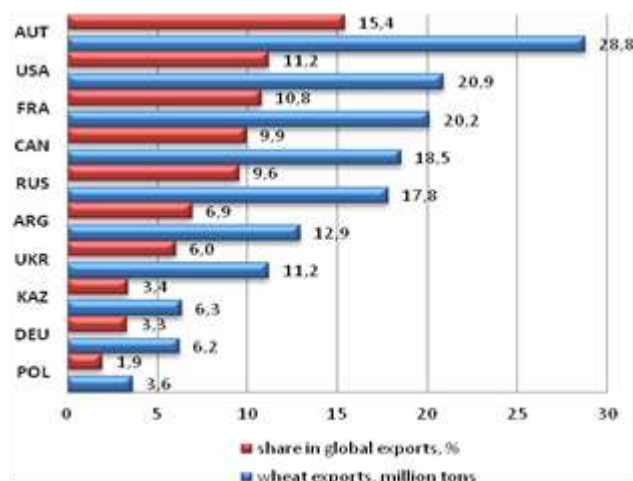


Fig. 2. TOP 10 countries in wheat exports in 2022
Source: compiled on the data from [6].

Next, based on the methodological approaches outlined by us in an earlier work [20], we will form a retrospective available time series of the gross grain harvest dynamics in Kazakhstan (Fig. 3).
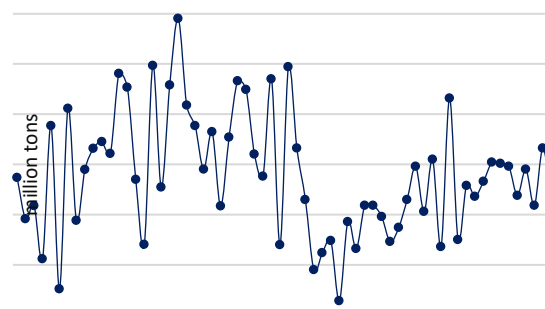


Fig. 3. Dynamics of the gross grain harvest in Kazakhstan in 1960-2023, million tons
Source: compiled on the data from [18, 19].

The following periods can be distinguished:

1) 1960 – 1978: the gross grain harvest increase by an average of 2.2% per year as a direct result of the virgin land development program. Before this program in 1949-1953 3.9 million tons per year were produced in Kazakhstan; while in 1954 – 1958 13.8 million tons were produced per year;

2) 1980s – mid-1990s: the gross grain harvest decrease due three global reasons for the decline: land degradation due to soil depletion of virgin lands; the crisis of the planned economy in the late 1980s; the transformation processes of the 1990s associated with the transition to a market economy.

3) 1998 – 2023: gross harvest is increased in the due to the development of food security policy and formation of the sustainable economic systems in Kazakhstan.

For the last stable period, we will conduct econometric modeling of the gross harvest dynamics of grain crops and construct a linear model with the following variables:

$$y' = 12.69 + 0.29 \cdot t, \quad t(b_0) = 9.13, \quad t(b_1) = 3.21, \quad R^2 = 0.40,$$

$$F_{(1,24)} = 10.32$$

where:

- $y'$ – model values of the gross grain harvest in Kazakhstan.

- $t$ – discrete variable reflecting the belonging of the levels of the time series to a year.

As can be seen from the obtained results of the econometric model estimation, the regression equation was obtained statistically significant in general according to the F-statistic of Fisher, and the parameters are significant according to the Student's t-statistic. The coefficients for the variable t indicate annual absolute increases in the gross grain harvest. In Kazakhstan the increase was 0.29 million tons.

Since the resulting model is statistically significant, we will make a forecast based on it, for this we will substitute the numbers of the forecast periods into the regression equation (Table 2).

Table 2. Forecast values of the gross grain harvest in Kazakhstan in 2024-2026, million tons

| Indicator | 2024 | 2025 | 2026 |
|---|---|---|---|
| Forecast value | 20,0 | 20,3 | 20,6 |
| Lower confidence limit of the forecast | 17,7 | 17,9 | 18,0 |
| Upper confidence limit of the forecast | 22,3 | 22,8 | 23,2 |

Source: author's calculations in the STATISTICA program based on data from [16].

The calculation results demonstrate a further increase in the gross grain harvest, but the model does not take into account natural and climatic conditions, such as drought or untimely precipitation.

Table 3 presents data on the dynamics and structure of production of the main agricultural grain crops.

Table 3. Gross harvest of grain crops of all types farms in Kazakhstan in 1995-2023: dynamics and structure, thousand tons

| Indicator | 1995 | 2000 | 2010 | 2020 | 2023 | Growth coefficient, 2023 to 1995 |
|---|---|---|---|---|---|---|
| Cereals (including rice) and legumes | 9,520 | 11,600 | 12,185 | 20,063 | 17,097 | 1.8 |
| Cereals (excluding rice) and legumes | 9,337 | 11,386 | 11,812 | 19,509 | 16,611 | 1.8 |
| Winter and spring wheat | 6,490 | 11,242 | 9,638 | 14,258 | 12,111 | 1.9 |
| Corn (maize) | 136 | 198 | 462 | 958 | 1,189 | 8.7 |
| Winter and spring barley | 2,208 | 2,265 | 1,313 | 3,659 | 2,614 | 1.2 |
| Winter and spring rye | 84 | 17 | 42 | 30 | 18 | 0.2 |
| Oats | 250 | 194 | 134 | 240 | 150 | 0.6 |
| Millet | 39 | 44 | 17 | 40 | 35 | 0.9 |
| Buckwheat | 53 | 16 | 27 | 40 | 83 | 1.6 |

Source: compiled on the data from [16].

The data presented in this table, clearly shows that over the reviewed period there has been an increase in the production of all grain crops, except for rye (a decrease of 80%), oats (a decrease of 40%) and millet (a decrease of 10%). The gross harvest of corn showed the greatest growth, which in 2023 increased by 8.7 times compared to 1995, which is due to the low base of comparison and crop growing demand for the domestic and world markets.

An analysis of the structure of grain production shows that wheat plays a key role in crop production in Kazakhstan; it occupies the largest share, and its share did not fall below 70% of the total volume.

For completeness, it is necessary to consider the balance of grain production and using (Table 4).

Table 4. Balance of resources and use of grain in Kazakhstan, thousand tons

| Indicator | 1995 | 2000 | 2010 | 2020 | 2021 |
|---|---|---|---|---|---|
| I. RESOURCES | | | | | |
| Stocks at the beginning of the year | 12,609.0 | 8,730.9 | 16,452.2 | 11,775.5 | 12,678.1 |
| Production | 9,505.5 | 11,565.0 | 12,185.2 | 20,065.3 | 16,375.9 |
| Import | 36.1 | 16.6 | 51.1 | 810.0 | 1,496.5 |
| TOTAL RESOURCES | 22,150.6 | 20,312.5 | 28,688.5 | 32,650.8 | 30,550.5 |
| II. USAGE | | | | | |
| Industrial consumption, including: | 11,160.5 | 2,063.6 | 6,787.8 | 5,938.5 | 4,931.9 |
| livestock food | 3,839.6 | 714.5 | 3,909.7 | 3,729.1 | 2,689.7 |
| seeds | 2,527.9 | 1,349.1 | 2,878.1 | 2,209.4 | 2,242.2 |
| Processed for food purposes | 4,288.6 | 2,616.9 | 5,035.8 | 4,447.3 | 4,025.5 |
| Other industrial use | 100.0 | 160.0 | 989.8 | 2,182.3 | 2,286.8 |
| Losses | 404.4 | 127.0 | 679.9 | 489.8 | 458.3 |
| Export | 4,083.3 | 5,683.5 | 5,552.8 | 6,556.6 | 6,851.1 |
| Personal consumption | N/A | 248.4 | 308.3 | 358.2 | 359.1 |
| Stocks at the end of the year | 6,906.8 | 9,413.1 | 9,334.1 | 12,678.1 | 11,637.8 |

Source: compiled on the data from [17].

Analysis of the data in the table demonstrates the high level of provision of the country's national economy with its own resources, exports tend to grow, grain imports are insignificant, reserves have minor fluctuations, and their variation is satisfactorily stable over time.

The structure of grain use is stable over time, so in 2021, 30% of production was used for industrial consumption, 25% for processing for food purposes, 14% for other industrial use, and only 2% for personal consumption.

Next, let's turn to regional data and assess the role of individual regions of Kazakhstan in the production of grain crops (Table 5).

Table 5. Dynamics of production of cereals (including rice) and legumes in the regions of Kazakhstan, thousand tons

| Region | 2010 | 2015 | 2020 | 2023 | Structure, 2023, % |
|---|---|---|---|---|---|
| Kazakhstan | 12,185.2 | 18,672.8 | 20,065.3 | 17,096.6 | 100 |
| Abai | - | - | - | 337.0 | 2.0 |
| Akmola | 2,141.9 | 4,434.7 | 5,093.9 | 3,215.5 | 18.8 |
| Aktobe | 64.4 | 164.9 | 498.6 | 421.5 | 2.5 |
| Almaty | 1,066.0 | 1,172.2 | 1,327.4 | 616.4 | 3.6 |
| Atyrau | 0.0 | 0.3 | 0.1 | 0.1 | 0.0 |
| West Kazakhstan | 76.3 | 95.4 | 279.3 | 310.8 | 1.8 |
| Zhambyl | 372.6 | 452.6 | 842.6 | 470.0 | 2.7 |
| Jetisu | - | - | - | 880.5 | 5.1 |
| Karagandy | 293.9 | 591.6 | 973.9 | 6,30.2 | 3.7 |
| Kostanay | 3,039.9 | 4,541.9 | 4,015.8 | 4,426.9 | 25.9 |
| Kyzylorda | 328.2 | 368.6 | 519.6 | 453.9 | 2.7 |
| Pavlodar | 232.1 | 575.5 | 750.4 | 407.5 | 2.4 |
| North Kazakhstan | 3,730.4 | 5,047.1 | 4,229.0 | 3,747.7 | 21.9 |
| Turkistan | 371.3 | 646.7 | 745.2 | 755.4 | 4.4 |
| East Kazakhstan | 467.7 | 713.0 | 773.9 | 386.8 | 2.3 |
| Astana city | 0.2 | 0.3 | 1.2 | 0.7 | 0.0 |
| Almaty city | 0.3 | 0.1 | 0.1 | - | - |
| Shymkent city | 0.0 | 0.0 | 14.3 | 12.0 | 0.1 |
| Ulytau | - | - | - | 23.6 | 0.1 |

Source: compiled on the data from [16].

The data presented in the table indicate that the production of grain in Kazakhstan is uneven across the territory. So there are three regions that contribute more than 65% to the country's production, these are: Kostanay Region - 25.9%, North Kazakhstan Region - 21.9% and Akmola Region - 18.8%. The current structure of the gross grain harvest is explained by natural and climatic conditions, since all three of these regions are located in the north of the country, on the border with the Russian Federation. These areas are characterized by lower spring and summer temperatures, which contributes to the vegetation of agricultural plants. Also in this area chernozems (black soil) are concentrated, which means land suitable for cultivation.

Next, we calculated the index of structural differences between the proportions of the number of people living in the regions of Kazakhstan with the shares of the gross grain harvest by region of the country. It is equal to 0.665, which indicates a high level of differences between the compared structures. Thus, the territories where grain is produced

do not coincide with the places of residence of citizens, i.e. with consumers. This raises problems with harvest storage and the logistical problem of delivering grains and their derivatives to the end consumer, which undoubtedly affects the cost of the finished product.

The results obtained during the study allow us to compare them with earlier works of other authors. In the study of Zh. M. Omarkhanova we find an original approach, dividing the regions of Kazakhstan into two groups: "agricultural" and "non-agricultural" [10]. At the same time, these groups complement each other by transferring goods from one region to another, thereby ensuring the commodity and food security of the country. The statement deserves attention, but the topic of high storage and transportation costs remains open. The author also doesn't consider the problem of price disparity between agricultural and industrial products.

The research team led by S. K. Mizanbekova, conducting a study of the grain economy of Kazakhstan, came to the following conclusion: "innovative activity, promising innovations for grain crop breeding and seed production systems, development of mechanization, land reclamation, chemical treatment, expansion and strengthening of transport routes, means of information support, management in the areas of grain production and market relations allow the formation of specialized grain zones" [9]. We are inclined to disagree with this statement, since the data we analyzed indicates natural and climatic factors, primarily weather conditions and soil composition, which led to the grain specialization of the three regions of the country.

Modern approaches to the determinants of economic processes are increasingly shifting the emphasis of policy towards interactions between actors of economic systems and the need to develop institutional interaction between them [5].

In the research of Derunova E. V. and the team, it is substantiated that directions for improving the activities of agricultural clusters are possible based on the development of an institutional approach and assessment of system efficiency [3, 4]. Limitations on extensive development and the transition to more intensive development in the grain cluster of Kazakhstan are possible not only through the use of innovative agricultural technologies, but also through increased interaction at all stages of production and logistics in agriculture.

The results of our study of the grain cluster in the Kazakhstan are relevant for many agricultural countries with a large territory. It is necessary to analyze the main components of agricultural systems and develop directions for its balanced development, taking into account spatial and strategic approaches both [14].

## CONCLUSIONS

The statistical analysis of the dynamics and structure of grain production in Kazakhstan allows us to formulate several conclusions.

1. The leaders in world wheat production are China and India, which is due to the large population of these countries, which must be provided with food, thereby high production helps with food security. Kazakhstan, according to the results of 2022, was not among the ten leading countries, but its share is significant and amounts to 2% of world production. In turn, the leaders in exports are countries such as Australia, the USA and France. Obviously, these states cover the needs of citizens and production in this product, and want to get additional income from agriculture. In 2022, Kazakhstan ranks 8th among the ten main exporting countries, with a value of 3.4% of world wheat exports. Thus, the republic has a significant position both in world production and in the export of wheat.

2. The main share in the gross harvest of grain and legumes is wheat, in 2023 it accounted for 73% of overall grain and legumes gross harvest. The main regions where grain (including wheat) is grown are Kostanay Region, North Kazakhstan Region and Akmola Region, which together in 2023 grew more than 65% of the total crop. At the same time, the country's population is concentrated in other regions, i.e. there is a discrepancy

between production and consumption, which leads to the threat of loss of food security in the long term and an increase in prices for the final product due to logistical costs already at the present time.

3. The dynamics of the gross grain harvest in Kazakhstan for the 1960-2023 period shows a mixed trajectory, where several periods of development could be highlighted: firstly, until 1980, when there was an increase in production, which is explained by the program for the development of virgin and fallow lands; secondly, the decline that began in the 1980s and lasted until the mid-1990s, which is associated with soil degradation and the transformation of the economic system; thirdly, the modern stage, which began in 1998, is characterized by continuous growth.

These data allow us to predict further growth in gross harvest at a rate of 290 thousand tons per year, provided there is no impact of negative factors.

In order to ensure food security in Kazakhstan, further modernization of its agriculture is advisable. One of the reserves for increasing grain production is increasing yields, improving seed quality, and using advanced resource- and energy-saving technologies. It is also necessary to effectively organize the processes of dissemination and implementation of innovations and competent structural policies in relation to human, natural, climatic and other resources in relation of the agriculture system development in Kazakhstan.

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