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SCENARIOS OF DEVELOPMENT OF THE IMPACT OF CLIMATE CHANGE ON LEGUMES DUE TO THE DIGITALIZATION OF KAZAKHSTAN

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The agricultural sector of Kazakhstan is of great importance and should continue to develop dynamically. However, due to the natural conditions in the country, that is, due to the sharply continental climate, this is not easy to do, and because of the large territory, this industry has great potential. In the future, Kazakhstan can make an important contribution to the global food supply.

Reducing the cost of farmed products, and improving their quality and competitiveness based on the efficient use of resources and scientifically based approaches is the main task of digitalization of agriculture. Providing the necessary information to rural producers will reduce transaction costs in the sale and purchase, simplify the supply chain of products from the field to the consumer, and reduce the shortage of skilled labour. The technologies used today in most farms are significantly outdated, and new progressive methods successfully used in the world have not yet received due attention and development in Kazakhstan [1]. However, food safety cannot be ensured without a careful approach. The problem of reforming the agro-industrial complex is especially relevant today. It is necessary to introduce new high-tech farming methods that would increase soil fertility, obtain stable yields at optimal costs, and lead the entire agro-industrial complex to a new path of innovative development. Without this, food security will not be possible. To date, the ministry has achieved the digitization of 23.7 million hectares of land, or 98.8 percent of the total sown area, to create accurate electronic field maps. In addition, 537 electronic applications for the shipment of 16,594 tons of diesel fuel have been generated. Farmers will be able to receive online advice on farming, agronomy, seed production and animal husbandry in 2020, and online lending for spring fieldwork will begin in 2019 [4, 5]. Digitalization is designed to improve the production

process by simplifying the procedures for obtaining subsidies and access to agrochemical analysis, space monitoring and weather data. The agricultural sector is the most vulnerable sector of the economy, largely dependent on the vagaries of nature. The impact of climate change on global food security will only increase. The intensity, seasonality and amount of precipitation will become increasingly unpredictable, which will significantly reduce the ability of the agricultural business to adapt to such changes.

An economic assessment and scenarios for the impact of climate change on digital farms of leguminous crops in Kazakhstan for 2020-2023 were carried out. The aim of the study is to analyze scenarios of the development of the climate change impact on leguminous crops and opportunities for farm digitalization in Kazakhstan. The experience introducing digitalization of land use is analyzed on the example of the activities of farms in Kazakhstan. For example, electronic maps of agricultural land have been introduced in Almaty, North Kazakhstan, Akmola and Zhambyl regions. Over the past three years, online monitoring of sowing and harvesting has been carried out in the northern regions. The work focuses on equipping agricultural machinery with GPS monitoring systems through satellite navigation, which helps to quickly track crop maturation, irrigation levels, plant diseases, etc.

Digital leguminous farmers work on the basis of GPS equipment and sensors that can determine the impact of climate change. The agri-food Sector Development Program for 2017-2020 supports precision agriculture, «smart» agriculture and the introduction of digital technologies among the main priorities.

According to the basic scenario, the economy of Kazakhstan will develop against the background of stabilization and adaptation to rapid changes and new foundations of international trade and logistics. The factor supporting economic growth until 2027 will be the increased dynamics of domestic demand, mainly from consumers, whose average annual growth will be 7.1%. At the same time, total expenditure on final consumption will grow by an average of 6.2% per year. The average annual growth rate of gross capital formation is expected at the level of 3.3% (Table 1). Forecast for the development of economic sectors: the average annual rate of real growth of the economy of Kazakhstan is 4%. Agro-industrial complex: average annual growth - 4.3 percent [2].

Table 1- Forecast indicators of GDP components for 2023-2027, in % to the previous year

Components	2022	2023	2024	2025	2026	2027	2023-27
	Assessment			Forecast			
Final consumption expenditure	96,8	105,2	105,5	105,7	107,3	107,1	106,2
Net exports of goods and services	140,5	99,2	100,2	100,6	89,8	89,1	95,6

Gross domestic product	102,1	104,2	104,2	104,4	103,4	103,8	104,0
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The development of the agro-industrial complex will be ensured through the implementation of the National Project for the Development of the Agro-industrial complex for 2021-2025. Thus, in the field of crop production, it is expected that the development of seed production will be positively influenced by the active introduction of seed traceability systems and equipping seed farms with modern machinery and equipment, as well as improving the activities of the republican scientific and methodological center of the agrochemical service and improving its material and technical base to increase the level of use of mineral fertilizers.

Within the framework of the Agribusiness Development Concept for 2021-2030, it is planned to introduce precision farming technology and digitalize all technological processes. Special attention will be paid to the breeding and breeding of new plant varieties using accelerated methods based on molecular biology and genetic engineering. This will allow scientific organizations to develop new high-yielding varieties of crops resistant to diseases and stressful situations every 5-6 years. In scenarios shows that to 2030 the leguminous crops yield will reach at least 10 c/ha [3].

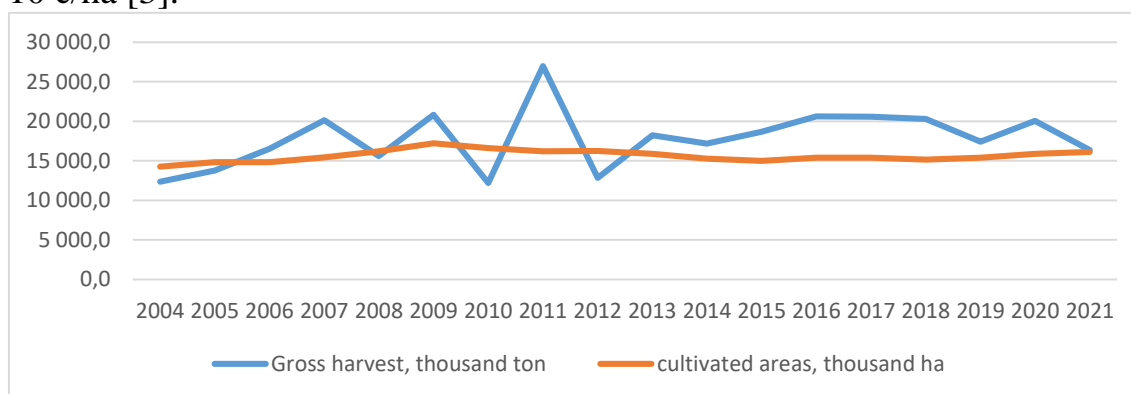


Figure 1. Dynamics of gross harvest and cultivated area of cereals and legumes in Kazakhstan

According to the report of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, the Bureau of National Statistics in 15000 (1000 ha) ha leguminous crops cultivated in 2004-2021 and during these years from the impact of climate change gross harvest varied (Figure 1). Growth in agriculture, with a forecast of 105.0%, was lower by 7.4 percent. The low figure is due to a decrease in crop production by 6.7 percent.

Every year farmers begin to cultivate more legumes, because of subsidies and for fodder. By continuing investment subsidies and expanding the leasing program of agricultural machinery through KazAgroFinance JSC, the level of agricultural machinery renewal will be brought to 6%, which will ensure sowing and harvesting in optimal time, as well as reduce additional costs for fuel and spare parts by 15-20 percent. The adoption of measures will increase the proportion of high-quality seeds from 93 to 98 percent and the level of mineral fertilizers from 20 to 29 percent. Investments in fixed assets in the agricultural sector will grow from 840.6 billion

tenge in 2023 to 1.8 trillion tenge by 2027. Different studies show scenarios, where developed countries, due to limited imports of energy resources and agricultural raw materials, will be exposed to high levels of inflation, including due to rising prices of key consumer goods (gasoline, diesel fuel, food and others). Kazakhstan has 8 percent of inflation in 2021 year.

When forming development scenarios, trends in the development of the world economy, the dynamics of world prices and the situation on world financial markets are taken into account as the main factors. In the updated forecasts of international financial and research institutions, the forecasts of growth of the global economy, as well as a number of developed countries, have been lowered, with an increase in inflation forecasts.

In 2022-2023, growth was expected to decline to 3.6% due to a slowdown in global economic activity. First of all, this is due to the escalation of the geopolitical confrontation between Russia and Western countries and restrictive quarantine measures in connection with new outbreaks of the COVID-19 coronavirus. It is predicted that these factors will lead to an acceleration of inflation, the emergence of an imbalance in trade and economic relations, an increase in uncertainty for investors and a decrease in entrepreneurial activity.

Manufacturing industry: average annual growth – 4.7%.

The production of food and beverages will be stimulated through attracting investments in the agricultural processing industry within the framework of the National Project for the Development of Agriculture for 2021-2025. At the same time, all measures of state support will be preserved: investment subsidies for reimbursement of part of expenses, interest rates on leasing and loans of agricultural entities, subsidizing the costs of processing enterprises for the purchase of raw materials, subsidizing part of the costs of farmers when handing over agricultural raw materials for processing (large and small cattle, oilseeds, corn, sugar beet, buckwheat). It is also planned to implement about 100 investment projects for the processing of agricultural products, which will ensure additional growth in production and export volume [4].

To promote domestic products on the domestic market, a legislative ban on unfair trade practices will be worked out. To ensure stable supply of products in the required volumes

in retail chains, meeting the needs of buyers in high-quality and safe products, the issue of developing their own standards and requirements for product suppliers by domestic trade entities will be worked out. This will create mutually beneficial partnerships between the supplier and the distribution network, as well as increase consumer confidence in the quality of products sold.

To increase the connectivity of the country's domestic market and ensure effective interregional cooperation, a trade and distribution system will be built that will bring together manufacturers, trade and logistics companies and retailers, as well as markets and convenience stores. The National Commodity Distribution System being created is a full-cycle infrastructure, from production to sale, which will be integrated into the country's trade infrastructure, forming a single ecosystem for a significant expansion of the agricultural sales market. The gross output of

agricultural products (services) decreased by 2.4 percent, which was due to a decrease in crop production by 6.7 percent (Figure 2).

Analysis of discrepancies between reporting and forecast data for 2021. According to the FSED for 2021-2025 (approved by the Government of the Republic of Kazakhstan on August 25, 2020, protocol No. 29, as amended on April 20, 2021), economic growth in 2021 was projected at 3.1%, actual growth was 4.1% (1.0 percentage points above the forecast level). The main factor behind the discrepancy between reporting and forecast data was the high volatility of the external market situation.

Thus, the revival of business activity and the stabilization of the epidemiological situation had a positive impact on the service sector. Significant growth rates were achieved in the provision of communication services - 114.6% and trade - 109.2%, which is 8.1 percentage points higher than the forecast level. and 4.3 percentage points respectively.

Growth in agriculture, with a forecast of 105.0%, was lower by 7.4 percentage points. The low figure is due to a decrease in crop production by 6.7%. Agriculture contributes to only 6 percent of Kazakhstan's GDP, however it remains an important sector for the economy of Kazakhstan [7, 8]. It provides employment to 18 percent of the working-age population, and, as such, is critical for addressing rural income generation as well as food security and poverty reduction. In addition, Kazakhstan is a major producer of agricultural commodities: the country is in the world's top 20 for the production of grains, including wheat and barley, and oilseeds, such as sunflower seed. The export of food and agriculture products accounted for 5 percent of Kazakhstan's total exports; a major part of agriculture exports (USD 1.7 billion in 2018) comes from the export of grain and flour. The export of meat and meat products, which reached USD 44.7 million in 2018, is noticeably higher than the same exports of USD 20.0 million in 2017. Forecasted that GDP growth to 3.1 percent and agriculture with trade will increase, but in facts agriculture get down to - 2.4 percent. It means that agriculture vulnerable to climate and productivity of crops from impact of climate change get down in 2021-2022 (Figure 2).

The growth of agricultural volumes is expected at a level of 4.3% in 2023. Exports are expected to increase to 72.2 billion US dollars, and imports - up to 40.2 billion US dollars. Unfavourable changes in natural and climatic conditions and instability of weather conditions are designated as threats to the development of the agro-industrial complex. One of the factors for obtaining sustainable yields is the observance of farms of the recommended set of varieties by ripeness group. Almaty, Zhetysu, Akmola, Kostanay and North-Kazakhstan regions are most exposed to these risks when growing leguminous crops.

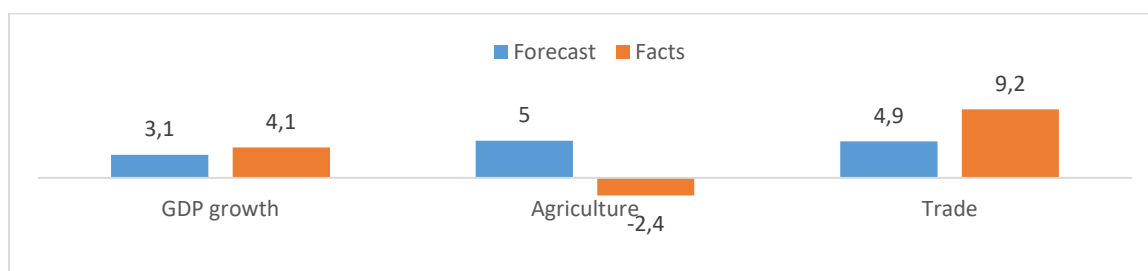


Figure 2. The discrepancy between growth rates forecast and actual data, %

According to the data of the regional departments of agriculture, in the republic, the share of early-ripening and medium-early varieties of legumes was 40.4%, mid-ripening - 41%, and medium-late - 13.9%. In general, the ratio of varieties of different ripeness groups in the regions is maintained (according to scientifically based standards, the percentage of medium late varieties should not exceed 20–30%). Climate change is having a devastating impact on the growth and yield of legumes. Natural disasters are the main type of stress that crops suffer from.

Different scientific research and reports of the National Hydrometeorological Service of the Republic of Kazakhstan show that scenarios of climate change impact different way to leguminous crops. Temperature extremes can particularly affect the resource and ICT sectors. Climate projections for the interim future period 2040–2059 show that will increase to 2.2 - 2.7C. The minimum temperature (Tasmin) under the 50th percentile, will increase by 2.3 - 2.8C [8, 9].

The highest annual absolute values are projected to be up to 3.1C in February, and up to 5.1C in March. Such an increase in summer days is significant, especially for the Southern and Western regions with semi-arid and arid climates. The number of hot days is the temperature index that indicates the annual number of days with a maximum temperature of over 35C. An increase in the number of hot days is a major cause of natural hazards such as droughts or heat waves. This is especially crucial for the Southern and Western parts of the country. A change in precipitation patterns increases the risks of floods and climate-related natural disasters such as landslides, mudslides and mudflows in mountainous areas [5].

A decrease in precipitation during summer months combined with an increase of surface air temperature can have important implications such as rapid depletion of soil moisture leading to drought conditions.

Kazakhstan's agriculture sector has serious challenges from climate change. The digitalization of legumes farmers will be helpful against climate change through forecasting and another technical way. Only by taking into account all external and internal risk factors, it is possible to reliably assess the actual state of the industry and develop prospects for its development. At the same time, weather risks turn out to be key for agriculture, since there is a dependence of crop production volumes on weather conditions, which in turn directly affects the livestock industry. Under unfavorable weather conditions, there is a shortage of fodder, which leads to a decrease in the productivity of livestock, a decrease in its livestock. This affects the increase in production costs, a decrease in the profitability of products and labour productivity. Climate change scenarios show that maximal and minimal temperature will increase to 2C and up, and precipitation will get down to 10-20 mm, which will affect to productivity of leguminous crops to a shortage of water in 2030.

The frequent heat stress and droughts will be especially in south and central Kazakhstan. The resulting drying up of pastures and reduced water availability for livestock.

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