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Environmental Components and Mechanism of Public-Private Partnership in the Area of Risk Insurance in Crop

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Abstract:

Crop risk insurance in Kazakhstan is an urgent problem for agricultural producers and insurers, since agriculture is in the zone of constant natural and economic risks, where the main share of risks is associated with weather events affecting the production of agricultural crops. In order to reduce natural risks in agriculture, to ensure the protection of the property interests of farmers in crop production from the consequences of adverse natural phenomena, measures are being taken by the state and business, however, there are problems that both agricultural producers and insurers face.

Public-private partnership has established itself as a successful tool for interaction between business and the state, and now in Kazakhstan a lot of work is being done for the qualitative growth and development of the PPP mechanism, which requires more active interaction between the state and business in the field of crop production.

Keywords: insurance; crop production; crops; agricultural producers; risks; insurance rates; government regulation; costs; agro-climatic zones; insurance indexation; public-private partnership.

JEL Classification: Q13; Q14; O33.

Introduction

Agricultural production is distinguished by a special risky environment, since natural and climatic risks are manifested in it, which are very dangerous and have the maximum effect on the final results of activities. At the same time, the economic damage caused by them is not only comparable with the scale of the financial results of commodity producers, but periodically exceeds them. Farms also suffer losses as a result of the impact of risks

traditional for any commercial activity (production, marketing, financial): the size of these losses is large, difficult to assess, and the consequences are disastrous.

The rare and constantly shrinking network of stations under new conditions, sharp differences in the hydrometeorological regime of individual regions of the state, the lack of microclimatic studies, etc. - all this significantly complicates the task of assessing resources using traditional methods and approaches, and in some areas makes it completely impossible. aggravated by inefficient use of resources, outdated infrastructure, little practical application of relevant standards and regulations, as well as poor environmental conditions and high levels of pollution.

The importance of agriculture in the economy of different countries is very different, however, with the growth of GDP per capita and structural transformations in the economy, the share of agriculture is decreasing, which is generally predictable. In some of the world's poorest countries, agriculture accounts for more than 30% of economic activity, and for the group of least developed countries as a whole, 27% of GDP.

1. Literature Review

The climatic conditions of the country, their changes, today should be considered not only as a source of more and more frequent natural disasters, as a reflection of negative changes occurring in the environment and harming the living conditions of the population, its health, the work of enterprises, transport, etc. Climatic conditions for any country - this is the same wealth as the wealth of its mineral resources, flora and fauna. Rational use of the wealth and diversity of the country's climatic conditions, including changing conditions, is the key to its stable development.

There is significant uncertainty in quantitative estimates of how expected climate change will proceed in the future and what impact they will have on ecosystems, economic activity and social processes in different countries and regions. Both positive and negative consequences are possible, depending on the level of development of the region and its climatic affiliation. Unfortunately, the accuracy of existing climate forecasts is currently low. None of the models can fully simulate the climate. Due to the aforementioned significant uncertainty of climate forecasts, the range of estimates of possible economic consequences of climate warming remains rather wide.

The economy makes new and more stringent requirements for the science of climate, which is objectively due to the complication of production processes, the growth of potential damage from natural disasters, the need for quantitative risk assessments, and other reasons. However, predictive information is often used incompletely and sometimes incorrectly by consumers, as a result of which the effectiveness of the decisions made is significantly reduced. Therefore, it became necessary to analyze the ecological components and the mechanism of public-private partnership in crop production.

The economic structure of the regions is based on their territorial location, agroclimatic conditions associated with natural and climatic zones, asymmetric distribution of cities, economic centers, deposits, favorable regions for agriculture, and so on. It is obvious that for the stable economic development of the regions, it is necessary to create conditions to ensure the competitiveness of agricultural products and to support the timely sale, processing and export of products. This, in turn, spurs a set of measures related to the optimization of customs tariffs and fees, the creation of favorable conditions for long-term business lending, and tax administration.

Agricultural risks not only affect the performance of agricultural producers, but they also affect the entire value chain of an agribusiness product. All stakeholders in the chain, from the supply of raw materials to the end consumer: financial institutions, government, raw material suppliers, buyers, agricultural producers, are exposed to these risks.

Agricultural insurance provides agricultural producers with protection from the impact of natural disasters by providing adequate compensation sufficient to enable them to continue operating after incurred losses, stimulating agricultural production and encouraging the flow of credit from banks and other financial institutions for agricultural producers.

In his book "Risk - management", N.N. Malashikhina notes that agricultural producers face many risks: fluctuations in prices, yields, partial or complete loss of resources and changes in government policy. In addition, agricultural production is subject to the risk of natural disasters and emergencies. Such natural hazards as drought, hail, flooding can lead to serious production losses (Malashikhina 2017).

According to O. Kiseleva in her publications on the stabilization of the financial situation of agricultural enterprises, of course, the indicators of the decline in yields, in particular, rice, vegetables and fruits were

influenced by many factors, one of which is climatic conditions. In this case, the weather risk is superimposed on the economic one, which makes it difficult to identify and analyze (Kiseleva 2016).

Kurmanbaev S.K., Alibaeva M.M. in their articles describe the need to identify effective ways to reduce agricultural risks, which are carried out on the basis of the development of scientifically based recommendations and require knowledge of the structure and sources of financial support provided by equipment, means of protection in crop production, financial guarantees of insurance coverage. The impact on the risk by the insurance method means that other methods do not fully compensate for possible damage and losses from various risks (Kurmanbaev and Alibaeva 2016).

Agriculture is one of the most risky sectors of the economy, since the dependence of the conditions and final results of agricultural activity on random, most often natural and climatic factors is very high. Therefore, the use of agricultural insurance programs acquires a special role in the solution to minimizing unforeseen financial losses (Eldieva 2018).

According to Goodwin B.K., Vandevier M.L., Deal J.L. agricultural insurance alone, without government support, is not able to provide adequate protection for agricultural producers. The financial participation of governments in agricultural insurance programs is due to the need to maintain the profitability of agricultural production, which in turn increases the investment attractiveness of the industry and prevents the outflow of resources from it in the long term, as well as contributes to the relaxation of social, political and ethnic tensions in society (Goodwin, Vandevier and Deal 2017).

Their studies examined the impact of crop insurance on agricultural production using an economic growth model. A basic model of agricultural economic growth was developed based on the Ramsey-Cass-Koopmans (RCK) model. Expanding the basic model to include uncertainty and the insurance mechanism, a risk model and a risk insurance model were built to study the impact of risk and crop insurance on agricultural production (Goodwin, Vandevier and Deal 2017).

Investigating the foreign experience of the agricultural insurance system Piterskaya L.Yu., Tlisheva N.A. describe the approaches to the organization and the degree of state participation in insurance of agricultural producers:

- with the leading role of the state, where it is the main regulator of the insurance market (Canada, Cyprus, Greece, India, Iran, the Philippines);
- with the prevalence of private insurance companies in the insurance market, in which the state basically only legislatively regulates the insurance market (Argentina, South Africa, Australia, Germany, Hungary, the Netherlands, Sweden, New Zealand);
- with a developed public-private partnership, where the market competition of insurance companies is harmoniously combined with reasonable government regulation based on various principles (USA, Portugal, Spain, Turkey, South Korea, Brazil, Chile, France, Italy, Mexico, Poland, Russian Federation) (Piterskaya and Tlisheva 2017).

Analytical material, representing not only the level structure of the protection of agricultural producers, but also the methodology of the formation and use of each of the structure elements is described in the works of Geraskina E.V., Suslyakova O.N. (Geraskina and Suslyakova 2015).

Analysis and comparison of different insurance schemes at the European level has shown the relative advantages of the potential of index products compared to other risk management schemes at the EU level, determining when a particular type of insurance is more appropriate to protect a certain vulnerability, taking into account the risk and environmental diversity in Europe.

Public administration through adhoc payments or disaster funds exists in most countries. In some countries, in most cases, government animal disease risk coverage is provided (eg Ireland, the Netherlands, UK, etc.) while crop risk coverage is privately provided (Table 1).

Kazakhstan historically has a government-backed compulsory agricultural insurance system. During the Soviet period, a national compulsory crop insurance plan was in effect from 1970 to 1991 and all state and collective farms participated in this scheme, which was based on several risks that provided limited compensation for production costs. After the Republic of Kazakhstan gained independence in 1991, agricultural insurance was forgotten for the next 12 years.

The existing crop insurance system in Kazakhstan is a public-private partnership (PPP) scheme that was established in 2004. The legal and regulatory framework and financial and organizational foundations for the implementation of the national crop insurance program in the Republic of Kazakhstan were laid down by Law No. 533-II of March 10, 2004 "On compulsory insurance in crop production" (Law of the RK On compulsory insurance in crop production).

Table 1. Special payments if necessary (ad hoc) and payments from funds for the last years (data according to forms)

Country	Available years	Total payments (in million euro)	Average payments / year (in million euro)	Comment
Austria	1995-2004	56	5,6	Frost, drought, flood
Belgium	1985-2002	309	17,2	Dioxin in animal husbandry, frost, drought, rain, pests
Bulgaria	2000-04	2	0,4	Pest Control Fund and others
Cyprus	2001-04	29	7,2	-
Czech	1995-2004	369	36,9	Flood, drought, frost
Denmark	-	-	-	Storm and damage to forest stands by storm
Estonia	-	0	0	No payments
Finland	1996-2005	114	11,4	Crop compensation scheme
France	1996-2005	1,556 (1)	155,6 (1)	Drought 67%, frost 19%, rain 13%
Germany	2004-06	337	112,3	Flood 2004 over 240 million euro; livestock diseases and preventive measures
Greece	1995-2004	701	70,1	-
Hungary	1999-2002	49	12,2	Frost, drought
Ireland	1999-2004	401 (1)	66,8 (1)	Animal diseases
Italy	2001-06	680	113,3	Drought and other risks not covered by insurance
Latvia	2000-05	19	3,2	Frost, drought, rain
Lithuania	2000-05	16	2,6	Frost, drought, rain
Luxembourg	-	-	-	There are no "as needed" payments for crops. No other data
Netherlands	1998	250	-	Heavy rain; help is no longer provided
Poland	-	10	10,0	Epidemic diseases
Portugal	last 10 years	30 (2)	3,0 (2)	-
Romania	last 5 years	57	11,4	Frost, drought, flood
Slovakia	-	-	-	No other data
Slovenia	1995-2004	98	9,8	Drought, hail, frost
Spain	2000-05	22	3,7	Frost, drought, rain
Sweden	-	-	-	Infectious diseases
United Kingdom	2001-05	1,898	379,5	Animal diseases
Total			919,9	

Source: compiled by authors according to InterconsultInfo. <https://allinsurance.kz>.

The law determined the procedure and conditions for the implementation of compulsory insurance of direct production costs (DPC) for agricultural producers growing strategic grains, oilseeds and other field crops. The implementation of the crop insurance system in the country is carried out through the system operators - the strategic planning department of the Ministry of Agriculture of the Republic of Kazakhstan, the Fund for Financial Support of Agriculture (FFSA), insurance organizations, Mutual Insurance Societies (MIA) and local executive bodies in each region and district.

The existing insurance system in crop production is mandatory and defines the terms of the standard policy of insurance of direct production costs, which all insurance companies and OBC are obliged to adhere to, including the insured crops and risks, the amount of the insured amount for each crop at each regional and district level. The law also prescribes indemnity and appraisal procedures that follow the standard direct operating cost insurance procedure.

The influence of risk factors considered by T.A. Verezubova, Z.A. Baymagambetova, A.M. Mukhitbekova is closely interrelated with the efficiency of agricultural enterprises, as a result of which it is usually much higher than in other industries and is difficult to predict. In the future, especially in market conditions, which in themselves are sources of non-determinism of processes due to the instability of the market situation, as well as the intensifying political and economic shocks in the world space. In such a situation, the significance of not only an accurate assessment of the degree of risk increases, but also the search for minimization of its negative consequences (Table 2) (Verezubova, Baimagambetova and Mukhitbekova 2018).

Table 2. Minimum and maximum insurance rates in Kazakhstan for compulsory insurance of crop production

Name of region	Insurance rate, in %	
	min	max
Cereals		
Akmola, Almaty, east Kazakhstan, Zhambyl, Kostanay, North Kazakhstan	1,78	3,48
Karaganda, Kyzylorda, Pavlodar, South Kazakhstan	3,17	5,83
Aktuibinsk, West Kazakhstan	5,21	9,15
Oilseeds		
In all regions	2,01	3,44
Sugar beet		
In all regions	5,76	8,39
Cotton		
In all regions	0,92	1,33

Source: compiled by authors

Creation of a joint public-private association of insurers - insurance companies, which is a single Administrator and implements the state policy of supporting farmers TARSIM (Turkey); Agroseguro (Spain, Portugal, Israel), etc., bears all the costs of maintaining the system.

Public-private partnership has established itself as a successful tool for interaction between business and the state, and now in Kazakhstan a lot of work is being done for the qualitative growth and development of the PPP mechanism, where more active interaction between the state and business in the field of crop production is necessary (Ablaev and Akhmetshina 2016).

The main criteria and achievements of public-private partnerships (PPPs) include:

- government co-financing of insurance premiums;
- joint co-financing of catastrophic losses;
- cooperation between companies and the creation of uniform conditions;
- unification of claims settlement.

A clear understanding is needed that state support for the agricultural insurance system is not limited only to the payment of subsidies for insurance premiums (Engelhard 2018).

In world practice, public-private partnership has established itself as an effective mechanism for optimizing budget spending, which allows you to successfully solve important problems of a public nature by attracting private financial and intellectual (human) capital (Shlafman 2017).

As international experience shows, studies by Shmelev S. E., Sagiyeva R. K., Kadyrkhanova Z. M., Chzhan Y. Y., Shmeleva I. S., the implementation of PPP projects is also a way to improve the efficiency of public sector management (Shmelev *et al.* 2018).

A comparative analysis of international experience in the implementation of PPP projects is considered in the scientific works of Akintoye A., Beck M., Kumaraswamy M. (2016), Rouboutsos A. (2015), Ullah F., Ayub B., Siddiqui S.Q., Thaheem M.J. (2016).

So, E.B. Domolatov, I.N. Dubina, A.N. Turginbayeva (2018) consider in their publications the importance of public-private partnerships (PPPs) for sustainable growth and increasing the competitiveness of the national economy, and also determine the constraining factors for the development of cooperation in the field of public-private partnerships and the use of its mechanisms in the development of innovative investment processes in the economy of Kazakhstan, including including the sphere of agriculture.

The peculiarities of the implementation of the mechanism of public-private partnership are highlighted in the studies of Efimov V.S., who believes that the ultimate interest of business should be taken into account, and business should act, taking into account the interest of the state and the social significance of those objects that are created, reconstructed or transferred to management (Efimov 2015).

2. Methodology

Focusing on the regional profile of PPPs by industry and spheres of activity at the end of 2019, which is presented in Table 3, where the numerator is the number of projects, the denominator is the share of the region in a particular industry in%, one can see that this is an insignificant share in agriculture.

Table 3. Regional PPP profile in agriculture at the end of 2019

Regions	Agriculture, forestry, fisheries	Total
East Kazakhstan	-	223/100
Almaty city	11/19	59/100
Kostanay	1/1	61/100
Akmola	½	53/100
Karaganda	3/3	104/100
Kyzylorda	1/1	115/100
Turkestan	-	143/100
Pavlodar	-	70/100
Aktuibinsk	½	46/100
Almaty	7/17	42/100
Shymkent city	-	31/100
Mangistau	-	25/100
Nur-Sultan city	2/4	46/100
North Kazakhstan	-	55/100
West Kazakhstan	-	13/100
Atyrau	1/3	36/100
Zhambyl	-	113/100
Total	28/2	1235/100

Source: compiled by authors

Since Kazakhstan is in the area of high risk agriculture, where the average annual frequency of drought is 40% (2 years out of 5), and in the west of the country it reaches 60% (3 years out of 5), the problem of frequent adverse weather events is further complicated by their systemic nature, when droughts or floods affect vast areas of agricultural land in the country, they can lead to massive (unpredictable) losses for agricultural producers (hereinafter - agricultural producers). The consequences of adverse weather conditions also affect the financial stability and solvency of agricultural producers, which for the most part are borrowers on loans and most often such loans are provided through government concessional loans.

The insurers themselves note that insurance of agricultural crops is unprofitable due to the high risk of agriculture in the regions of the country and inadequacy of insurance rates. The loss also depends on the activities of the agricultural producers themselves, who do not seek to improve production technologies, and in some cases do not comply with certain crop norms, which often leads to the loss of crops even with a slight deterioration in weather conditions. In these conditions, an important task for the state is to ensure the efficiency of investments, as well as to support and stimulate the growth of agricultural production.

According to the National Union of Agricultural Insurers (NSA), the main group of risks that caused insured events are phenomena associated with drought, mainly atmospheric, and dry winds. They account for more than 72% of payments. The next in importance is the risk of frost, which led to 21% of payments, then hail - about 5% of payments, and closes the list with freezing of winter crops - less than 2% (Unified Association of Agricultural Insurers).

If we talk about the Republic of Kazakhstan, the procedure for obtaining an insurance payment and confirming an insured event is so complicated that some farmers do not even apply for payment. Insurance rates do not take into account the actual risks of agricultural production, depending on the region. In such a situation, it is easier for farmers to pay a fine than to participate in the insurance system and receive an amount disproportionate to their risks.

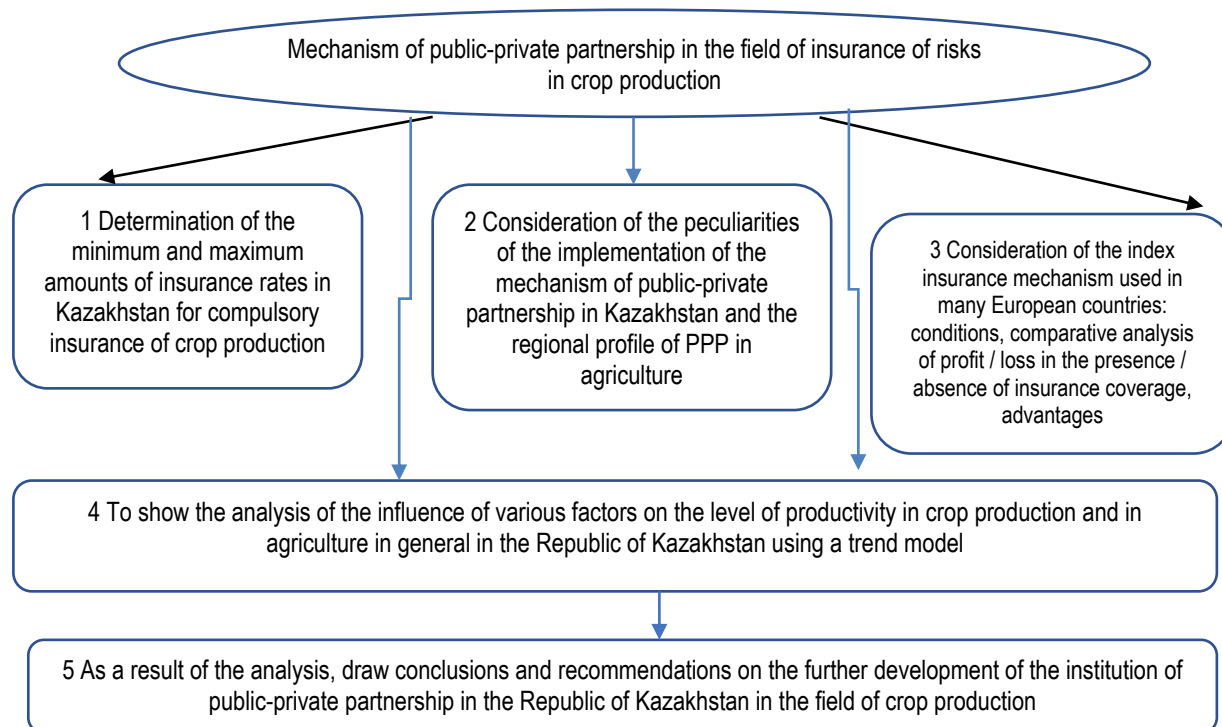
The sole shareholder of Kazakhstan Public-Private Partnership Center JSC is the Government of the Republic of Kazakhstan represented by the Ministry of National Economy of the Republic of Kazakhstan, whose mission is to create conditions for partnership between the state and business, develop and combine their potential for implementing PPP projects and increasing the volume of private investments in the country's economy. If we consider the sectoral structure of projects, then agriculture, including crop production, accounts for only 2% (Zhikibaeva 2019).

Therefore, it is necessary to improve the scientific and methodological foundations of public-private partnerships, to develop and create conditions for wider practical application of mechanisms and models of PPP in such industries as crop production, animal husbandry, adopting the advanced experience of developed countries, while implementing socially significant projects (Cong and Ma 2018).

Based on the assessment of the development of public-private partnership in the field of crop production, it is necessary to analyze the influence of various factors on the level of productivity in crop production and in agriculture in general in the Republic of Kazakhstan for the further development of the institution of public-private partnership in the crop production industry and the insurance mechanism.

With the purposeful work of the public-private partnership of the insurance industry and government agencies, as well as with an interest in the agricultural sector, the emergence of working models of index insurance in Kazakhstan is possible in the coming years, which presented a completely new tool based not on human subjective perception, but on the calculation of machines and objective data. The necessity of regulation of insurance of risks of agricultural producers in crop production of the republic to reduce natural risks in agriculture, to ensure the protection of property interests of farmers from the consequences of adverse natural phenomena has been substantiated.

Figure 1. Research questions



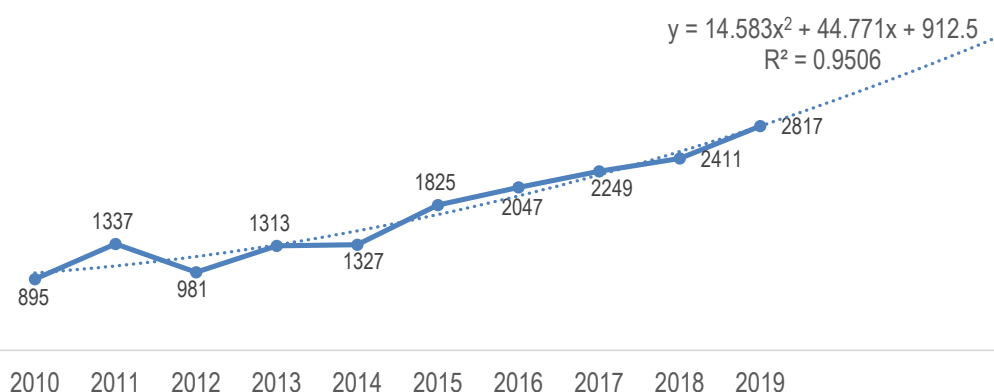
Source: compiled by authors

3. Data and Analysis

In accordance with the strategy "Kazakhstan 2050" in the agro-industrial complex, the main directions in the industry were to increase the food security of the country, the formation of an agricultural business, an increase in the competitiveness of domestic products and an increase in sales, both in the domestic and foreign markets, a decrease in the level of food imports, the introduction of an effective system of state support for agricultural production.

Agriculture creates about 5% of the country's gross domestic product (hereinafter - GDP). In 2019, the gross output of crop production amounted to 2.8 trillion tenge (Figure 2).

Figure 2 - Gross output of products (services) in crop production of the Republic of Kazakhstan for 2010-2019, in billion tenge



Source: Compiled by authors based on the source data of the Committee on Statistics of the Republic of Kazakhstan for 2013-2018

At the end of 2019, geographically, the most developed regions in terms of gross output of agricultural products (services) are Almaty region (16.1% of the gross output of agricultural products (services)), North Kazakhstan region - 13.9%, Turkestan region - 12.2%, East Kazakhstan region - 10.2%, Akmola region - 9.5% and Kostanay region - 6.8%.

Accordingly, the gross harvest of major crops has the following production volumes (Table 4).

Table 4. Gross harvest of major crops

Year	Cereals and legumes	Oil seeds cultures	of them: salted seeds (in weight after revision)	Potato	Vegetables of open and closed ground	Melons and gourds	Sugar beet
2010	12 185,2	775,4	328,9	2 554,6	2 576,9	1 118,2	152,0
2011	26 960,5	1 141,9	409,1	3 076,1	2 877,7	1 248,0	200,4
2012	12 864,8	976,8	400,3	3 126,4	3 061,5	1 649,9	151,6
2013	18 231,1	1 498,0	572,7	3 343,6	3 241,5	1 713,0	64,6
2014	17 162,2	1 547,6	512,8	3 410,5	3 469,9	1 928,0	23,9
2015	18 672,8	1 547,5	534,0	3 521,0	3 564,9	2 087,6	174,1
2016	20 634,4	1 902,4	754,9	3 545,7	3 795,2	2 070,9	345,0
2017	20 585,1	2 359,3	902,6	3 551,1	3 791,1	2 094,0	463,2
2018	20 273,7	2 693,6	847,7	3 807,0	4 081,9	2 142,5	504,5

Source: Compiled by authors based on the source data of the Committee on Statistics of the Republic of Kazakhstan for 2013-2018

The sown area of agricultural crops over the past 5 years was about 21 million hectares and changed insignificantly, the main changes were noted in its structure. A significant share of crops was allocated to wheat, but due to the policy of diversification of crop production, aimed at avoiding monoculture and expanding the area of other crops, wheat plantings have decreased since 2011, respectively, this affected the productivity of the main agricultural structures (Table 5).

Among the main fodder crops in 2019, the largest harvest of corn for fodder was collected and amounted to 12,501,640.4 centners. The gross harvest of fodder grains and legumes, respectively, was 352 187.6 centners and 309 947.1 centners. The yield of forage crops for silage (without corn) amounted to 405,385.3 centners, root crops and melons were harvested 1,383,246.3 centners and 47,009.0 centners, respectively.

In terms of processed crop products, the largest share of imports is noted for sugar (42%), and taking into account the import of raw cane sugar, imports reach 97%. At the same time, the production capacities of sugar factories are loaded by 37.1%. Table 6 presents data on some indicators of import of crop products for 2018–2019, which indicate an increase in volumes for these products.

Table 5. Productivity of the main agricultural structures
(centners per hectare)

Year	Cereals and legumes	Oil seeds cultures	of them: salted seeds (in weight after revision)	Potato	Vegetables of open and closed ground	Melons and gourds	Sugar beet
2010	8,0	5,0	4,4	143,0	214,4	177,0	174,3
2011	16,9	6,7	4,6	167,2	222,9	186,1	188,2
2012	8,6	6,1	5,9	165,9	234,0	206,8	168,2
2013	11,6	8,0	7,0	181,5	238,7	212,4	267,7
2014	11,7	7,8	6,7	184,3	243,0	217,1	240,6
2015	12,7	8,1	7,6	185,5	245,8	221,0	232,5
2016	13,5	9,6	9,3	190,4	250,0	221,4	285,5
2017	13,4	9,7	10,2	194,2	253,7	224,2	274,4
2018	13,5	9,7	10,0	197,9	257,3	224,2	305,3

Source: Compiled by authors based on the source data of the Committee on Statistics of the Republic of Kazakhstan for 2013-2018

Table 6. Indicators of import of crop products for 2018-2019

Indicator	2018		2019	
	Tons	thousand US dollars	tons	thousand US dollars
Total	1 401774,7	896 479,7	1 709 015,1	901 495,8
Potato	32 108,3	8 697,0	36 512,1	5 975,2
Tomato	65 217,1	45 228,3	43 397,0	39 305,7
Onion, garlic	157 422,5	22 737,9	143 465,5	29 657,3
Cabbage	68 103,6	12 273,9	65 729,6	19 651,8
Carrots, turnips, beets	68 566,2	10 260,6	68 194,7	12 499,7
Cucumbers	14 648,1	7 117,5	5 990,6	5 844,5
Wheat	86 663,0	9 493,6	359 131,7	54 108,9
Rye	1 090,9	129,5	1 336,1	122,2
Barley	47 035,3	6 610,6	38 553,6	6 462,5
Oats	725,5	96,8	1 899,1	192,4
Corn	4 086,7	5 033,1	7 618,3	5 964,8
Rice	9 800,4	5 916,7	21 960,0	12 336,0

Source: Compiled by authors based on the source data of the Committee on Statistics of the Republic of Kazakhstan for 2013-2018

Table 7. Indicators of export of crop products for 2018-2019

Indicator	2018		2019	
	tons	thousand US dollars	tons	thousand US dollars
Total	10 003657,5	1 850 005,4	9 358408,1	1 994459,3
Potato	153 024,6	17 760,0	262 971,3	22 598,3
Tomato	23 997,9	18 948,1	19 649,9	16 611,2
Onion, garlic	73 249,5	10 296,2	110 856,7	16 347,4
Cabbage	31 956,6	5 455,7	46 642,4	11 611,6
Carrots, turnips, beets	7 653,7	755,6	6 888,3	1 183,8
Cucumbers	8 194,3	6 683,4	9 202,7	6 049,8
Wheat	6 198 355,4	971 803,4	5 262 744,4	1 002 806,0
Rye	-	-	22,0	13,6
Barley	1 754 981,2	293 537,2	1 625 455,6	296 501,0
Oats	12 492,6	1 452,4	22 740,7	3 959,0
Corn	49 584,0	9 445,6	86 733,1	16 880,0
Rice	96 938,3	26 233,7	91 033,7	24 673,5

Source: Compiled by authors based on the source data of the Committee on Statistics of the Republic of Kazakhstan for 2013-2018

The problem of lack of quality raw materials to load production capacities is acute for the entire processing industry as a whole. The production of cereals and flour fully covers domestic consumption. The export indicators of crop products for 2018-2019 are presented in Table 7.

In the regional aspect, we can see that among the regions for the export and import of agricultural processed products are Kostanay, Almaty, Almaty (Table 8).

Table 8. Export and import of agricultural processed products

Region	2018		2019	
	export	import	export	import
Republic of Kazakhstan	1 133 507,0	2 424 534,8	1 114 967,2	2 602 361,0
Akmola	46 608,9	39 337,8	38 575,1	41 420,9
Aktuibinsk	3 861,0	131 217,3	9 285,3	116 131,5
Almaty	82 869,2	189 955,4	109 739,7	212 826,8
Atyrau	2 965,9	22 437,8	3 177,9	25 985,1
East Kazakhstan	26 756,1	50 215,9	28 484,1	63 678,0
Zhambyl	26 482,4	86 264,3	7 795,1	86 248,0
Karaganda	36 107,3	177 802,7	37 145,3	161 012,4
Kostanay	269 489,0	124 459,6	210 634,6	127 575,7
Kyzylorda	7 908,2	5 077,5	7 352,0	7 008,0
Mangistau	459,3	23 738,0	274,5	25 213,9
Pavlodar	12 842,0	52 145,6	19 475,5	65 142,6
West Kazakhstan	60 795,4	33 691,9	77 322,9	43 153,0
Turkestan	84 338,6	16 831,1	77 832,8	31 121,3
North Kazakhstan	50 613,3	43 386,1	54 898,0	44 202,7
Nur-Sultan city	50 793,8	112 028,9	54 289,0	128 086,9
Almaty city	205 788,0	1 226 461,3	205 516,0	1 330 511,3
Shymkent city	164 828,3	89 484,0	173 169,4	93 043,0

Source: Compiled by authors based on the source data of the Committee on Statistics of the Republic of Kazakhstan for 2013-2018

4. Application functionality

We will build a trend model to identify the predicted values of crop production and all agriculture in the Republic of Kazakhstan for 2020-2021 for wheat and other crops. To do this, compose the following table 9.

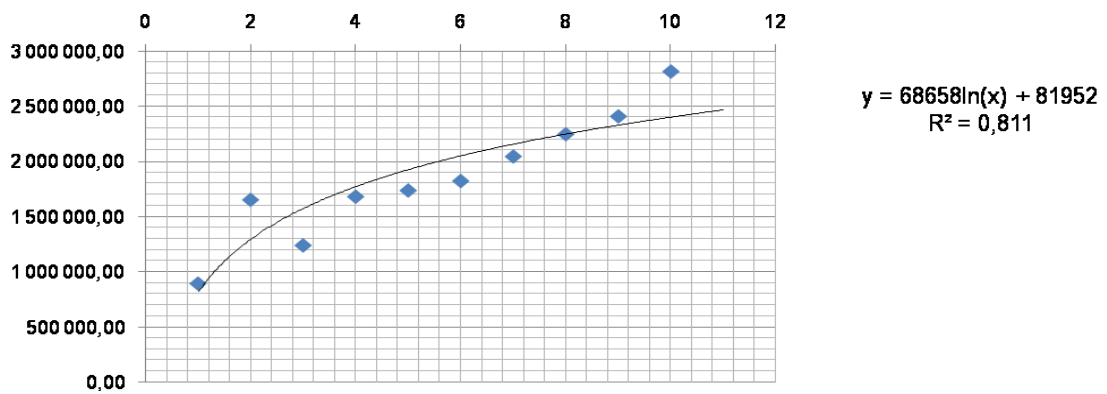
Table 9. Indicators of gross crop production in the Republic of Kazakhstan for the period from 2010-2019

No	Years	Total for agricultural services	Plant growing
1	2010	1 822 074,1	895 425,2
2	2011	2 720 453,4	1 654 428,5
3	2012	2 393 619,0	1 241 517,0
4	2013	2 949 485,0	1 683 851,4
5	2014	3 143 678,1	1 739 436,4
6	2015	3 307 009,6	1 825 236,7
7	2016	3 684 393,2	2 047 580,8
8	2017	4 070 916,8	2 249 166,9
9	2018	4 474 088,1	2 411 486,7
10	2019	5 151 163,0	2 817 660,6

Source: compiled by authors according to the "Methodology for calculating the gross output of products (services) of agriculture, forestry and fisheries", approved by order of the Chairman of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan

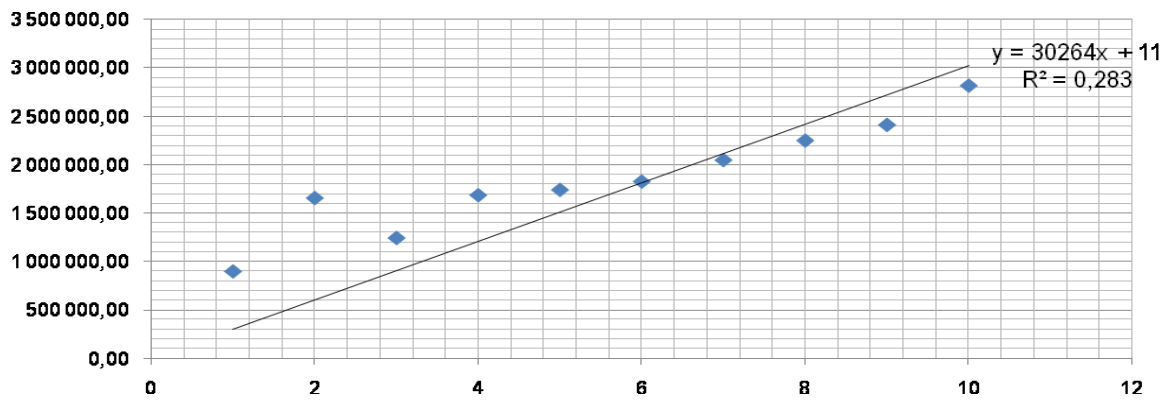
The estimation of the parameters of the trend equation based on the data in Table 9, will be performed using the tools - the graph of the function and the approximation coefficient in Excel (Figure 3, 4, 5, 6, 7) and will be presented in Table 10 (Sedelev 2019).

Figure 3. Indicators of gross output in crop production of the Republic of Kazakhstan for 2010-2019 and a graph of the logarithmic trend based on these data, in million tenge



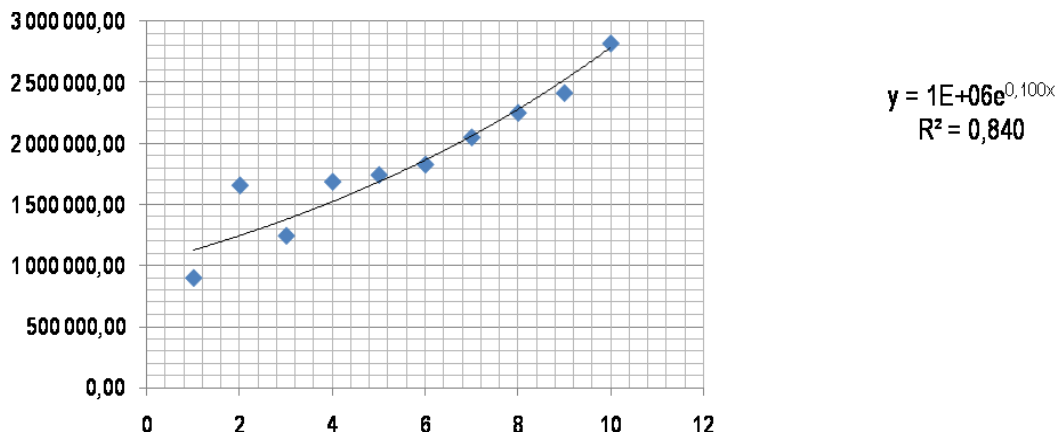
Source: compiled by authors

Figure 4. Indicators of gross output in crop production of the Republic of Kazakhstan for 2010-2019 and a linear trend graph based on these data, in million tenge



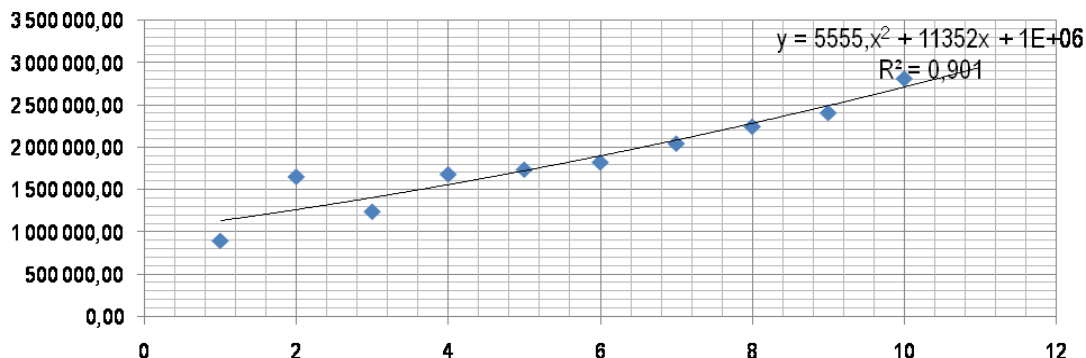
Source: compiled by authors

Figure 5. Indicators of gross output in crop production of the Republic of Kazakhstan for 2010-2019 and an exponential trend graph based on these data, in million tenge



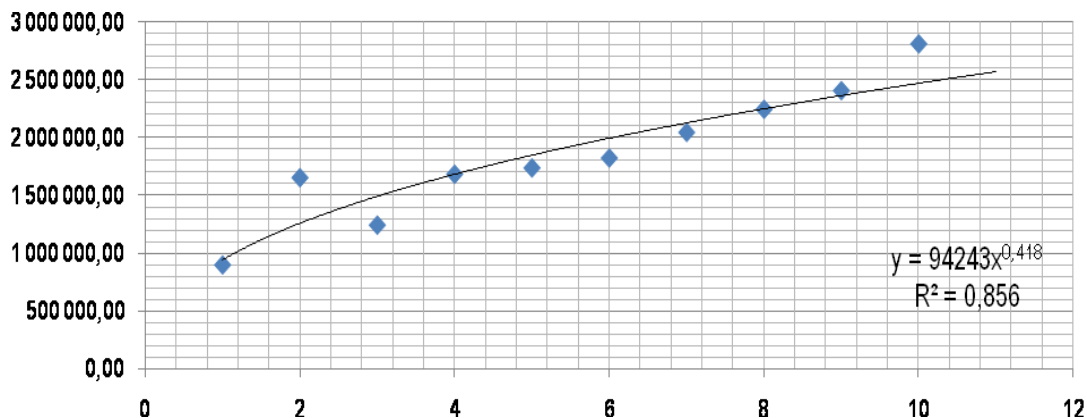
Source: compiled by authors

Figure 6. Indicators of gross output in crop production of the Republic of Kazakhstan for 2010-2019 and a graph of the polynomial trend based on these data, in million tenge



Source: compiled by authors

Figure 7. Indicators of gross output in crop production in the Republic of Kazakhstan for 2010-2019 and a power-law trend graph based on these data, in million tenge



Source: compiled by authors

Table 10. Equations of dependence of indicators of gross output of products (services) of agriculture in the Republic of Kazakhstan for the period from 2010-2019

No	Trend indicator	Trend equation	Approximation coefficient
1	logarithmic	$y_t = 2000 + 1000 \ln(t)$	$R^2 = 0,8252$
2	linear	$y_t = 2000 + 321,162t$	$R^2 = 0,9471$
3	exponential	$y_t = 2000 \cdot e^{0,0982t}$	$R^2 = 0,9351$
4	polynomial	$y_t = 2000 + 152,013t + 15,377t^2$	$R^2 = 0,961$
5	degree	$y_t = 2000 \cdot t^{0,3983}$	$R^2 = 0,9011$

Source: compiled by authors

As we can see from the graphs of functions of different dependences of indicators of gross crop production and gross output of agricultural products (services) in the Republic of Kazakhstan from 2010 to 2019 (Figures 3-7, Table 10), it is best to take the equation where the approximation coefficient is closer to 1. In both cases, it is a graph of a polynomial function.

The general view of this model is as follows:

$$y_t = b_0 + b_1t + \beta_2t^2, \tag{4.1}$$

Thus, the polynomial trend equation for gross crop production is:

$$y_1 = 1000 + 113,524t + 5,5556t^2, \tag{4.2}$$

And the equation of the polynomial trend for gross agricultural output is:

$$y_2 = 2000 + 152,013t + 15,377t^2 \quad 4.3$$

where b_0, b_1, b_2 – measured in billion tenge.

Let us determine the predicted values of the considered indicators for 2020 and 2021 years, for this, we substitute the values

$t_1 = 10, t_2 = 11$. Then we get:

- for crop production the forecast will be:

$$y_{2020} = y(10) = 1000 + 113,524 \cdot 10 + 5,5556 \cdot 10^2 = 2690,8$$

$$y_{2021} = y(11) = 1000 + 113,524 \cdot 11 + 5,5556 \cdot 11^2 = 2920,992$$

- for all agriculture, the forecast will be:

$$y_{2020} = 2000 + 152,013 \cdot 10 + 15,377 \cdot 10^2 = 5057,83$$

$$y_{2021} = 2000 + 152,013 \cdot 11 + 15,377 \cdot 11^2 = 5532,76$$

In general, despite the conditions of the pandemic, there is a positive trend in the agricultural sector, which is due to the fact that this market is a priority for the economy of Kazakhstan. Farmers and agricultural producers are supported by the state under the Program for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2017-2021 (Program for the development of the agro-industrial complex).

Currently, there are only two insurance companies left on the market that provide compulsory insurance in this segment. Initially, there were slightly more players - six, but they canceled their respective licenses under the influence of a very high loss ratio, exceeding 100% in recent years.

For example, in the West Kazakhstan region, with a 30% loss of sown areas, no more than 67% of crops are insured in total, and in Kostanay region, with a total loss of crops up to 4%, 95% of the crops are covered by insurance. In this regard, an analysis and corresponding calculations were carried out, which showed the need to change tariffs, standards of costs per hectare. According to experts, real tariffs will contribute to the transition to the cultivation of crops adapted to the area and the observance of agricultural technologies. As for the cost standards, they have not been revised since 2009.

As a result, insurance became unprofitable, with the loss of crops, the farmer received a payment that did not correspond to the costs. Now, in order to avoid an increase in the burden on the farmer, the cost standard will increase gradually over 3 years. Therefore, the level of participation of insurance companies in crop insurance is very low, since insurance in crop production is the least profitable of the 9 classes of compulsory insurance in the Republic of Kazakhstan.

According to the statistics of the National Bank of the Republic of Kazakhstan, as of January 1, 2019, the volume of insurance premiums in compulsory insurance in crop production collected by two insurance companies that did not refuse this type of insurance amounted to more than 394 million tenge (Table 11, 12).

Table 11. Receipt of insurance premiums in crop production for the period from 2010-2017 (in thousand tenge)

Name of the insurance (reinsurance) company	2010	2011	2012	2013	2014	2015	2016	2017
JSC "DSK Halyk Bank of Kazakhstan" Halyk - Kazakhinstrakh"	212311	242993	179813	232164	161787	105462	102735	83089
JSC "Grain Insurance Company"	209843	144764	161423	237767	318006	286619	314668	312160

Source: compiled by authors according to data of National Bank of the Republic of Kazakhstan

Table 12. Insurance payments in crop production for the period from 2010-2017 (in thousand tenge)

Name of the insurance (reinsurance) company	2010	2011	2012	2013	2014	2015	2016	2017
JSC "DSK Halyk Bank of Kazakhstan" Halyk - Kazakhinstrakh"	341380	111088	231369	37309	45480	27917	2464	3484
JSC "Grain Insurance Company"	336588	447	677258	270285	941659	128659	19238	72482

Source: compiled by authors according to data of National Bank of the Republic of Kazakhstan

To develop a competitive economy of Kazakhstan, including supporting agricultural producers, the state developed and adopted the state program "Digital Kazakhstan" for 2018-2022, which contributes to raising the culture of agriculture, centralizing the database and improving the system of financial and credit support of agricultural producers. There is a great potential for transformations in agriculture using digital technologies, and in the context of a full-scale digitalization program, agriculture is capable of reaching a qualitatively new level of development and becoming a driver of the country's economy.

The index insurance mechanism used in many European countries was launched in the spring of 2019 in Kazakhstan in a "pilot" mode.

Index insurance is an alternative form of insurance when payments are made not on the basis of an assessment of the individual damage caused to the insurance object (crop or income of the agricultural producer), but on the basis of the behavior of a specially constructed index.

Modern digital technologies have played a key role in the development of index insurance, which makes the process completely transparent for both the policyholder and the insurer. The emergence of index insurance in Kazakhstan was facilitated by the development of the QOLDAU platform for agriculture. There are about 200 thousand farmers in Kazakhstan, and more than 160 thousand are already users of the platform. At first, it functioned only as a registrar for electronic grain receipts - securities that confirm ownership of the grain stored in the elevator. The system monitored the movement of grain online, prevented attempts to ship more or less, did not allow issuing receipts for volumes exceeding the capacity of the elevator, simplified the search for partners and provided an opportunity to buy or sell grain by pressing a few buttons.

The SMI (soil moisture index) is proposed as an index. The main advantages of this insurance product are:

- simple and uniform technique;
- standardized and transparent structure of the insurance contract;
- international risk reinsurance (top 5 in the world rating);
- exclusion of administrative expenses of the insurer and the policyholder (online);
- the occurrence of an insured event is recorded on the basis of an independent source of information (data of remote sensing of the earth and web service from VanderSat);
- lack of a human factor in risk (weather index);
- receiving and processing data even in cloudy weather (passive microwave radars on European satellites).

In this case, the insurance conditions are as follows (Table 13) (Digital platform Qoldau).

Table 13. Index insurance conditions

Index	Three-phase drought insurance (arable land)		Product 2: Two-phase drought insurance (arable land, pasture and hayfield)		Product 3: Excess moisture in the soil
	cereals	oilseeds	cereals	oilseeds	cereals and oilseeds
Insurance period	15 May – 15 August	15 June – 15 September	15 June – 15 August		15 August – 15 October
Insurable value, tenge / ha	30,000 (cost standard)		30,000 (cost standard)	from 7,600 to 19,000 (feed cost or cost standard)	30'000 tg / ha (cost standard)
Rate, %	4.8% of the insured amount		3.2 % of the insured amount		2.43 % of the insured amount
Premium tg / ha	1440		960	from 243 to 608	729 tg
Maximum insurance payment, %	48% of the insured amount		33% of the insured amount		20% of the insured amount
Maximum insurance payment, tg.	14400		9900	from 2 508 to 6 270	6 000 tg
In the absence of an insured event	12% of insurance premium		12% of insurance premium		12% of insurance premium

Source: compiled by authors

Using the fields in Kostanay region as an example, let us consider a comparative analysis of profit / loss in the presence / absence of insurance coverage under the following conditions (Table 14):

- cost standard - 30000tg / ha;
- sown area - 1000 ha
- product 1: three-phase drought insurance.

Table 14. Comparative analysis of profit / loss in the presence / absence of insurance coverage

Condition	Availability of insurance	Yield	Sowing and harvesting costs	Insurance costs	Subsidizing 50% of the premium **	Total expenses excluding subsidies	Total expenses including subsidies	Total income	Profit / loss excluding subsidies *	Profit / loss taking into account subsidies **
Drought	No	0,6 t / ha	30 mln tg	0 tg	-	-	30 mln tg	21 mln tg (0,6 t/ha*1000ha*35000 ₸)	9 mln tg	-
Drought	Yes	0,6 t / ha	30 mln tg	1,44 mln tg	0,72 mln tg	31,4 mln tg	30,72 mln tg	21 mln tg (0,6 t/ha *1000ha*35000 tg) + 14,4 mln tg insurance payment	3,9 mln tg	4,6 mln tg
Drought	No	1,2 t / ha	30 mln tg	0 tg		-	30 mln tg	42 mln tg (1,2 t/ha *1000ha*35000 tg)	12 mln tg	-
Drought	Yes	1,2 t / ha	30 mln tg	1,44 mln tg	0,72 mln tg		30,72 mln tg	42 mln tg (1,2 t/ha *1000ha*35000 tg) + 172,8 thousand tenge cashback	10,7 mln tg	11,4 mln tg

Source: compiled by authors

The development of organizational and operational systems and procedures for an index insurance program in collaboration with leading insurance companies, the insurance regulator and other key players includes:

- development and formulation of insurance contracts,
- a web platform that supports the following functions: a rating tool that determines net rates, technical rates and loads for determining commercial rates, policy registration
- underwriting procedures,
- claims settlement and payment procedures.

Building on international scientific collaboration in climatology and modeling, this will provide an opportunity to expand the value proposition of the CAT loss model and support new climate insurance proposals, both now and in the future. The main advantage of integrated models will be a better understanding of feedback loops and cascading effects within and between sectors. And this is already a necessity, since in connection with climate change and climatic conditions in Kazakhstan, the following climatic problems can be identified that affect the development of agriculture, which need to be addressed not only by the state, but also by the entire world community involved in global warming on the planet (Official site of Agroinfo):

1. Increase in interannual and intra-annual variability of river runoff.
2. Uncertainty about the impact of the reduction in glacier area on river flow.
3. Increased demand for irrigation water due to higher evaporation rates as a result of higher air temperatures and due to reduced availability of water resources per capita.
4. Reducing the volume of reservoirs.
5. Imperfect irrigation system with high water losses and low crop productivity.
6. Increase in groundwater table due to poor management of irrigation systems and lack of drainage facilities.
7. Lack of transboundary infrastructure for flow control and glacier monitoring.

The analysis showed that the system of regulation of the agrarian sector is one of the key determinants of the development of agriculture. The main findings are as follows:

- firstly, the role of agriculture in the country's economy plays one of the key values;
- secondly, as the systematization of theoretical approaches carried out by the author has shown, ideas about the role of agriculture in social development have always been a reflection of the economic realities of the period in question and have changed under the influence of technological and socio-economic transformations of the agricultural sector;
- thirdly, the development of agriculture is based on the corresponding agrarian policy of the state. The author considered that the degree of government intervention in agriculture, responding to the complication of agrarian markets, change of technological structures, modernization of the social structure of society, has consistently expanded from “point” irregular impact to the restructuring of a comprehensive system of state regulation of the industry (Paptsov 2018).

Conclusion

Serious problems that agricultural production constantly faces (including climatic features), as well as its specific features, increase the lag of agricultural enterprises in the application of modern management tools. Strategic planning has not yet entered the practice of most agribusiness entities. However, without developing a scientifically grounded strategy for the development of the industry at all levels of management, it is impossible to overcome the crisis and lay the foundation for the advanced development of the agricultural sector of the economy (Bizhdov 2019).

For a more efficient use of financial resources allocated to support insurance by the state and ensure the financial stability of agricultural production in general, it is necessary:

- take into account the financial condition of agricultural producers, since subsidies are compensatory in nature and are provided after payment of 100% of the insurance premium, which greatly hits the pocket of the insured;
- to form a single line of insurance products, including inexpensive ones, for which state support is provided;
- develop a balanced tariff policy;
- to coordinate the actions of all participants in agricultural insurance in the system of compensation for damage from natural (catastrophic) disasters;
- to introduce a system of independent assessment of damage and a unified procedure for settlement of losses under insurance contracts, provided with state support;
- to revise or abolish the minimum threshold of crop loss;
- to reduce the gap between the subsidy rate and agricultural insurance tariffs;
- to give more powers to the regions in determining the priority directions for the development of the agricultural sector.

Authors analyzed the state of agriculture in Kazakhstan, and also showed what kind of state support investors and heads of agricultural enterprises can receive when developing development plans, in particular, in crop production. Based on the data of the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan, the authors considered the influence of various factors on the level of productivity in crop production and in the whole of agriculture in the Republic of Kazakhstan using a trend model, as well as an analysis of these indicators. As a result of the analysis, conclusions and recommendations were made regarding the further development of the institution of public-private partnership in crop production in the Republic of Kazakhstan and showing a mechanism using insurance indexation.

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