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Stukach, Victor and Saparova, Gulnar and Sultanova, Guzel and Saginova, Saniya

a) Omsk State Agrarian University (Omsk, Russian Federation), b) Financial Academy (Astana, Kazakhstan e-mail: saniya.saginova@gmail.com, c) JSC “National Agency for Technological Development (Astana, Kazakhstan), b) Financial Academy (Astana, Kazakhstan e-mail: saniya.saginova@gmail.com

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## **Agriculture of Kazakhstan: mutual influence of infrastructure institutions on the development of agricultural production...**

V. F. Stukach <sup>a)</sup>, G. K. Saparova <sup>b)</sup>, G. T. Sultanova , S. A. Saginova <sup>b)</sup>

a) Omsk State Agrarian University (Omsk, Russian Federation),

b) Financial Academy (Nur-Sultan, Kazakhstan ),

c) JSC "National Agency for Technological Development (Nur-Sultan, Kazakhstan),

b) Financial Academy (Nur-Sultan, Kazakhstan e-mail: [saniya.saginova@gmail.com](mailto:saniya.saginova@gmail.com))

*The article presents the main trends in the indicators of infrastructure development of the agro-industrial complex of the Republic of Kazakhstan. The dependence of agricultural production volumes on the development of social and transport infrastructure is studied. The mutual influence of infrastructure institutions on the dynamics of agricultural production development is shown. The study showed that the development of social and production infrastructure of agriculture in Kazakhstan remains unstable. This circumstance creates prerequisites for the implementation of a negative scenario in the development of rural areas. Shortcomings in the formation of rural infrastructure can lead to inhibition of reproduction processes in the agricultural sector, which will negatively affect the provision of the country's population with products from agricultural raw materials. The article substantiates the position that the formation and development of infrastructure in the agricultural sector is a necessary condition for effective interaction of subjects of main and auxiliary production, which contributes to the formation of general prerequisites for the development of agriculture. The results of the study can be used by the state in the process of developing and implementing agricultural policy, taken into account when investing in social, transport and industrial development of the village.*

*Keywords: agricultural products, food security, agriculture, infrastructure, social infrastructure, rural population, investment attractiveness.*

## **Сельское хозяйство Казахстана: взаимное влияние инфраструктурных институтов на развитие сельскохозяйственного производства.**

СТУКАЧ, Виктор; САПАРОВА, Гульнара; СУЛТАНОВА, Гузель; САГИНОВА, Сания.

V. F. Stukach <sup>a)</sup>, G. K. Saparova <sup>b)</sup>, G. T. Sultanova , S. A. Saginova <sup>b)</sup>

a) Омский государственный аграрный университет (Омск, Российская Федерация), [vic.econ@mail.ru](mailto:vic.econ@mail.ru)

b) финансовая академия (Нур-Султан, Казахстан),

c) АО "Национальное агентство по технологическому развитию" (Нур-Султан, Казахстан),

б)финансовая академия (Нур-Султан, Казахстан) e-mail:  
saniya.saginoва@gmail.com

***Аннотация.** В статье представлены основные тенденции изменения показателей инфраструктурного развития АПК Республики Казахстан. Исследуется зависимость объемов производства аграрной продукции от развития социальной и транспортной инфраструктуры. Показано взаимное влияние институтов инфраструктуры на динамику развития аграрного производства. Исследование показало, что развитие социальной и производственной инфраструктуры сельского хозяйства в Казахстане остается нестабильным. Это обстоятельство создает предпосылки для реализации негативного сценария в развитии сельских территорий. Недостатки в формировании инфраструктуры села могут привести к торможению воспроизводственных процессов в АПК, что негативно скажется на обеспечении населения страны продуктами из сельскохозяйственного сырья. Обосновывается положение о том, что формирование и развитие инфраструктуры в аграрной сфере является необходимым условием для эффективного взаимодействия субъектов основного и вспомогательного производства, способствующее формированию общих предпосылок развития сельского хозяйства. Результаты исследования могут быть использованы государством в процессе разработки и реализации аграрной политики, учитываться при инвестировании средств в социальное, транспортное и производственное развитие села.*

***Ключевые слова:** аграрная продукция, продовольственная безопасность, сельское хозяйство, инфраструктура, социальная инфраструктура, сельское население, инвестиционная привлекательность.*

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## **Agriculture in Kazakhstan: mutual influence of infrastructure institutions on the dynamics of agricultural production development**

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## **Introduction**

Public health, living standards and life expectancy are an essential feature of food security. A significant indicator of food security is the satisfaction of a person's need for adequate nutrition, which his working capacity and life expectancy depend on. Unfortunately, according to the forecasts of the Food and Agriculture Organization of the United Nations (FAO), the number of people worldwide suffering from chronic malnutrition increased from 2015 to 2016 by 11%.<sup>1</sup>

Food and transport security is also interrelated, since the insufficient development of transport infrastructure can cause loss of crops, damage to food during transportation, violation of delivery terms for agricultural commodity producers of pesticides, mineral fertilizers, agricultural machinery, which negatively affects both production and consumption of food.

Under the conditions of today, the interconnection of agricultural production with the problems of environmental and energy security grows stronger, since as the productive forces develop, the production of raw materials, agricultural products and food becomes increasingly dependent on environmental factors that change under its influence, and energy resources. The welfare of the society is ensured by the sustainable development of the social infrastructure, which is attributable to a complex set of factors, such as housing provision, housing improvement, as well as stable food support and maintenance of the optimal state of the natural environment.<sup>2</sup>

The problem of food security is exacerbated by the need to strengthen the protection of consumers' rights and environmental conservation. In this connection, a study conducted by the Economist Intelligence Unit with the financial support of Du Pont is of interest; based on the results of this study, the country's global food security index has been calculated. The rating is a scale of 0 to 100, where 100 is total security

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<sup>1</sup> The Food and Agriculture Organization of the UN (FAO): official website [electronic resource]. – URL: <http://www.fao.org> (access date: 15.01.2018)

<sup>2</sup> Kaygorodtsev A. (2006). Economic and Food Security (questions of theory, methodology and practice: Scientific Monograph / A.Kaygorodtsev – Ust-Kamenogorsk: Media Alliance, 384 p.

(Table 1).<sup>3</sup>

Table 1

### Global Food Security Index, 2017

Ranking	Country	Index	Ranking	Country	Index
1	Ireland	85,6	46	Botswana	63,1
2	USA	84,6	47	Egypt	61,8
3	UK	84,2	46	Belarus	63,0
4	Singapore	84,0	47	Bulgaria	62,9
5	Australia	83,3	59	Paraguay	56,5
6	The Netherlands	82,8	60	Kazakhstan	56,0
7	Germany	82,5		...	
8	France	82,3	77	Pakistan	47,8
9	Canada	82,2	78	Uzbekistan	47,5
10	Sweden	81,7	79	Philippines	47,3
11	Austria	81,6	80	Myanmar	44,8
	...		81	Nepal	44,5
41	Russia	66,2	82	Senegal	44,2
43	Mexico	65,8	83	Cambodia	43,3
44	South Africa	64,0		...	
45	China	63,7	113	Burundi	25,1

In the world ranking of countries with ensured national food security of 2017, Ireland and the West European countries are leading, while in 2016 the leading place was occupied by the USA.<sup>4</sup>

### Theoretical basis

The countries actively cooperate with the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and their special bodies, such as the Codex Alimentarius (FAO Food Code), where representatives of over 170 states and the European Commission as the representative of the EU work in 30 different committees to elaborate standards, guidelines and codes of industry practice on food quality and safety.<sup>5</sup>

The experience of Canada is also of interest to Kazakhstan; this is in particular a new five-year program adopted by the government (until 2012) and called “Canada's Northern Strategy” [1]. Under the program, the state subsidized food parcel orders for

<sup>3</sup> The Global Food Security Index: official website [Electronic resource]. – URL: <http://foodsecurityindex.eiu.com> (access date: 15.01.2018).

<sup>4</sup> Global Food Security Index. Humanitarian Encyclopedia [Electronic Resource] // Center for Humanitarian Technologies, 2006–2018 (access date: 03.01.2018). URL: <http://gtmarket.ru/ratings/global-food-security-index/info>

<sup>5</sup> Codex Alimentarius. International Food Standards (2018). Retrieved from: <http://www.fao.org/fao-who-codexalimentarius/home/en/> (date of access: 16.01.2018).

the population living in remote settlements, that is, about 135 settlements with a total population of more than 100,000 people. The program was extended to three territories of Canada and covered a number of northern settlements. Given the vast territory of Kazakhstan, the Canadian model could be applied to help the population of remote rural settlements.

In the United States, the regional specialization has become the most important organizational and economic principle of rationalizing the agrarian sector, providing the dynamic development based on high bioclimatic potential and the benefits from innovative achievements [2,3].

Experience of a range of countries indicates that food self-sufficiency cannot always be achieved even in highly developed countries. For example, in Japan the level of food security is only 50%, but its national companies offer means to import the demanded volumes of food and, being a largest net exporter, to achieve in general the level of export earnings far exceeding the cost of food imports [4].

Economic security (as an integral part of national security) is the priority of the state policy. In turn, economic security as a systemic formation includes a range of components (food, foreign economic, energy, investment, technological, industrial, transport and communication and other components).

According to Russian scholars, close relationship in ensuring social and economic security means the same that the public security and is an objective social and economic phenomenon that becomes a modulator of scientific and technological progress and a factor in the intensification of production [5].

In the history of forming the food security, an important role is played by international organizations, predominantly by the United Nations. Under the United Nations auspices, the human right to a decent life is officially fixed in the Universal Declaration of Human Rights (1948) and in the International Covenant on Economic, Social and Cultural rights (1966) [6]. In the context of globalization, climate change, global financial crises, there is a threat of a decrease in food consumption, and hence the problem of ensuring food security. At the UN summit in 2015, one of 17 mail goals was: “To put an end to hunger, to achieve food security, to improve nutrition and to promote sustainable agriculture”.<sup>6</sup> Based on this goal, FAO developed a concept for sustainability in food and agriculture, which identified five principles: improving the efficiency in the use of resources; conserving, protecting and enhancing natural resources; protecting and improving rural livelihoods, equity and social well-being; enhanced resilience of people, communities and ecosystems to external influences; responsible and effective governance mechanisms.<sup>7</sup>

Any country has certain national interests which include food security, import substitution policy, increasing the incomes of domestic producers, which are increasingly difficult to ensure in the context of growing globalization and strengthening of integration processes. Agrarian production is influenced by

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<sup>6</sup> United Nations (2018). Retrieved from: <http://www.un.org> (date of access: 15.01.2018).

<sup>7</sup> Sustainable Food and Agriculture (2018). Retrieved from: <http://www.fao.org/sustainability/en> (date of access: 16.01.2018).

integration factors both within the country and in a global scale. The sustainable development of AIC sectors is the basis for ensuring food security.

Complex internal macroeconomic conditions in which the AIC of Kazakhstan develops are based not only on the influence of external factors, but also on those related to the consequences of the economic reforms of the 1990s. Kazakhstan for a long time had no comprehensive approach to the development of rural areas, which was accentuated only on agricultural production.

Kazakhstan joined the WTO on November 30, 2015, which strengthened the integration processes in the agrarian sector. From 2015, the interaction among the EAEU countries is increasing. In 2016, the directions "On coordination of sales and marketing policy of the Member States of the Eurasian Economic Union for agricultural products and foodstuffs" and a number of other projects were adopted at the interstate level. In these conditions, the problems of harmonization of obligations to the partners in the EAEU and the WTO have become more acute.

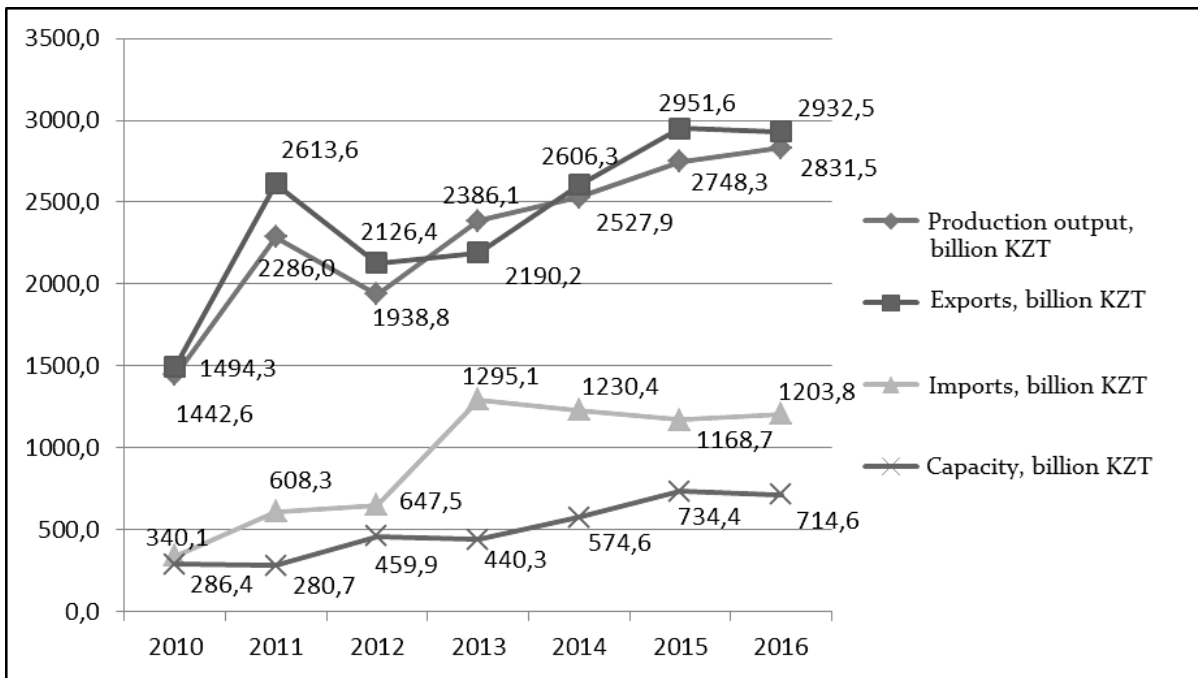
According to Kazakhstani researchers, due to the WTO accession, Kazakhstan reduced the level of support to its agricultural consumers through the measures of the yellow box and increased financing of the green box measures.<sup>8</sup>

The order "On approval of the rules for subsidizing the cost of laying and growing (including restoration) of perennial plantations of fruit and berry crops and grapes" (No. 4-1/168 of February 27, 2015) abolished subsidies for cheaper cost of fuel-lubricants and reduced cost of material assets in crop production, and subsidies per hectare and public procurement. At the same time, the subsequent order "On the approval of the subsidy rules on reimbursement in terms of costs incurred by the agroindustrial complex subject in investing" (No. 9-3 / 726 of August 7, 2015) was aimed at encouraging private investment, increasing the state support for subsidizing the costs of processing enterprises for the purchase of agricultural products for the deep processing production.

In the EAEU countries, the share of support for agriculture remains relatively stable, but not uniform, as Fig. 1 shows.

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<sup>8</sup> Developing recommendations on the use of the advantages of integration processes within the EAEC to increase the efficiency of the development of agro-industrial production in Kazakhstan: report on research (interim.): Kazakh Research Institute of AIC Economics and Rural Development; adv. A.B.Moldashev, exec.: G.A.Nikitina [and others]. Almaty, (2016). p.125. # 0115PK01936. Inv.No. 0216PK00998.



**Fig.1.** Dynamics of agrarian products market of Kazakhstan for 2010-2016

Source – Authors’ preparation based on the data of the Committee on Statistics of Kazakhstan

For 2010-2016, the agrarian market capacity grew 2,5 times, the production grew almost 2 times, but the volumes of imports continue to exceed the export volumes for many types of basic agricultural products, which negatively affects the problem of food security.

Entering the international markets leads to expansion of production due to strengthening of interconnection of rural territories. We should agree with opinion of the scientist Robson P. that the change in scale as a direct consequence of integration is a result of so-called statistical and dynamic factors that allow economic entities to make wide use of the opportunities of a more voluminous market [7].

The absence of a differentiated approach has led to a not enough rational territorial allocation of productive forces and an underdeveloped industrial and social infrastructure of rural areas. This is evidenced by the Rural Areas Development Program, which was developed for the period 2004-2010, and, unfortunately, has not been fully implemented.

The number of settlements with high development potential has increased to 2,610, or 2.5 times compared to 2004; with the average development potential, it decreased by 1,406, or by 25%; with a low development potential, it decreased by 674 units or 7.6 times, as evidenced by Table 2.

Table 2

**Dynamics of rural settlements development for 2004-2010**

Indicators	2004	2010	Discrepancy (+;-)



Amount		7660	6970	-690
Population		7193,9	7520,5	326.6
Rural settlement with high development potential	Number of RS	1062	2610	1548
	Population, thousand people	1566,9	3909,3	2342,4
Rural settlement with average development potential	Number of RS	5664	4258	-1406
	Population, thousand people	5329,1	3591,7	-1737,4
Rural settlement with low development potential	Number of RS	776	102	-674
	Population, thousand people	288,2	19,4	-268,8

Source: Authors' own preparation based on report of Kazakh Research Institute of AIC and rural development

However, there are doubts about the rate of increase in the number of rural settlements with a high development level due to the predominance of the administrative approach to defining and classifying rural settlements in a particular category in terms of their socio-economic development, as well as about internal migration, a significant outflow of rural population to cities.

Protection of industrial and social infrastructure of rural areas is one of the priorities in recent years. It should be noted that the number of social enterprises has significantly decreased, as evidenced by the statistics evidence such as a lack of kindergartens, schools, consumer services, and health care institutions.

According to the Kazakh scientist, the material and technical base of cultural and leisure facilities remains in a critical position: 34% of rural settlements have cultural institutions and 42% have libraries; unsatisfactory condition of roads remains relevant for 70% of districts; there is a backlog of villages from the city according to the share of housing; lack of engineering development of rural settlements [8].

Foreign scientists highlight the need to structure relations between urban and rural areas, changes in relations to nature, "greening" the economy [9,10].

In modern market conditions, agrarian production is basically only a preparatory basis for ensuring the functioning of the processing industry. In this regard, many technological functions performed earlier directly in the agrarian sphere have moved away and interact with the corresponding industrial, trade and service industries and services that act as an infrastructural environment.

As A.Izotov notes, applying to the economy sphere, the infrastructure should be understood as a set of activities and industries that provide its maintenance in order to create the required conditions for the full-scale operation of production [11].

Some scholars define social infrastructure as the sphere of society's life, where the required level of well-being is created, which determines the level of quality of life of the population outside the immediate sphere of production, while others imply the economic relations between society and its members about the consumption of specific goods [12,13].

One should agree with the opinion of Russian scientists that one of the functions of infrastructure is the creation of general conditions for increasing the efficiency of reproduction, since the infrastructure complex does not create an actual product, but services are the main product of this complex [14].

As for the concept of the AIC infrastructure, there is the complexity of its formulation in connection with the fact that agricultural production in a market economy is a kind of raw material appendage for the processing industry, and it actually pushes it out of the system of services and industries that are considered as an infrastructure. However, the infrastructure, in our opinion, includes both social and economic conditions that ensure the development of the production process.

It should be agreed with scientists that the content of the concept “the infrastructure of rural areas” is reflected in specific indicators of the quality of its residents` life, which include the average life expectancy, and the innovative activities of its inhabitants, conditions for recreation, etc. [15].

The economic development of the country's agrarian economy at each level is determined by a certain model of the infrastructure and the specifics of its formation.

The major development of enterprises in the sphere of material services such as wholesale trade, transport, warehousing, gas, electricity, and water supply was observed in the conditions of an extensive period of economic activity in the agroindustrial complex. With regard to the period of intensification of agricultural production, it should be noted that the sharp lag in the development of infrastructure services and industries from the main industries is directly dependent on the nature of the investment policy in the agroindustrial complex. This is reflected in the demand for additional development of construction services, information services, etc. The current period makes such circumstances so at the present stage, in order to overcome the crisis in the agrarian sphere, there is a need for an effective development of the industrial and social infrastructure of the domestic agroindustrial complex, which will create the necessary prerequisites for entry of the agrarian economy of the country in the stage of post-industrial development.

Such infrastructure serving the agroindustrial complex should include enterprises and organizations that will ensure the general conditions for the development of production and livelihoods of people. Infrastructure, as an integral system, is divided into social and production by its intended purpose.

Social and industrial infrastructures as a complex serve for all stages of agroindustrial production. That is why their role is very important in raising the level of the agroindustrial complex efficiency and intensification that is steadily growing.

In the current market conditions, a quantitative and qualitative state of the objects of the AIC social and industrial infrastructure will play a very important role in the expanded agricultural production. Their use will be accompanied by the external benefits of society, which exceed the marginal private benefits.

Determining the position of the production and social infrastructure in the current system of the country's agricultural mechanism and its relationships with many other elements of the management system, it is necessary to consider existing

approaches to the structural formation of the agroindustrial complex as a reproductive and economic system. Proceeding from these preconditions, the forms of influencing the elements of the production and social infrastructure on the reproduction process in the agroindustrial complex will be as follows:

- organizational form of influence in the impact on the level of transaction costs of enterprises and organizations of the regional agro-industrial complex;
- fund-forming form of influence in meeting the needs of all organizations and enterprises of the regional agroindustrial complex in reproduction of fixed funds;
- technological form of influence in modernization of production of construction products and application of innovative technologies;
- integration form of influence in the development of economic interregional relations;
- investment form of influence in direct and indirect investments in the development of social and industrial infrastructure (macro level) and the formation of investment attractiveness of the AIC (regional level).

In the Republic of Kazakhstan, there is the problem of poor quality of infrastructure in all its components. This situation is complicated by a small inflow of investment, weak interaction between different sectors, a high degree of depreciation of fixed assets and an outdated regulatory system.

At the same time, it should be noted that the infrastructure should potentially be one of the most important competitive advantages for the Kazakhstani regions, especially when taking into account the length of the country.

Some researchers attribute the deterioration of rural areas to the degradation or underdevelopment of infrastructure. At the same time, they note a number of reasons, focusing on the social or transport infrastructure. Therefore, we believe that the problem of infrastructure support of the territory should be considered as a whole complex of problems.

Population decline, rural degradation and other factors directly depend on the infrastructure (social, production, transport).

In the current period, the share of agricultural organizations in the structure of agricultural production is clearly decreasing. For example, the registered legal entities amounted to 12,989 in 2013 and 12,858 in 2015.

Just in recent years, there has been an increase in this indicator.

The consequences of these circumstances were as follows:

- 1) in the field of industrial infrastructure
  - a large and unsatisfied request for specialists to work at the AIC enterprises,
  - backlog of the level of equipment and technology from foreign competitors,
  - replacement of the condition of the production process's resource base (including fertilizers and pest control agents),
  - instability of pricing policy in the market of financial services providers (insurance, loans, etc.), petroleum products, etc.
  - constant changes in the structure of owners,
- 2) in the field of social infrastructure

- reduction of health facilities,
- insufficient number of cultural and recreation facilities,
- the difference in the levels of training in the educational institutions of city and village,
- lack of facilities in the service sector (hair salons, etc.),
- a significant difference in the standard of living of urban and rural populations (wages, social security),
- lack of prospects for personal development.

According to the Committee on Statistics of the Ministry of National Economy of Kazakhstan, the number of hospital organizations in 2015 decreased to 901 compared to 2008, when the number of hospital organizations was 1,041.

### 3) in the field of transport infrastructure

- lack (or insufficient quantity/quality) of communications for production organizations,
- lack (or insufficient quantity/quality) of communications for rural residents,
- insufficient routes of public transport means.

Among the problems hampering the development of the agroindustrial complex, there are small-scale production, low animal productivity, underdevelopment of the feed industry, inadequate financing of agricultural enterprises and commodity producers [16].

The diminishing role of the agrarian sector also had a negative impact on the development of rural areas. Ignoring the social laws, the subjective opinion of some leaders that everything depends on the will of people and public institutions led to the fact that cooperation has lost its fundamental principles and is nearing extinction throughout the post-Soviet space at the present stage [17]. Unfortunately, rural workers were not prepared to changes, to creation of a socially-oriented market economy. It is known, farmer cooperation is the more common form of integration, and Sweden, the Netherlands, and Denmark are an example of such “cooperative countries” [18].

The above circumstances can be listed further, and their significance and level of influence on the development of a particular territory depend on many factors such as the degree of remoteness from large settlements, the policies of local and regional authorities.

Let us assess the dependence of agricultural production of the Republic of Kazakhstan on the level of development of rural production, social and transport infrastructure.

For a factor analysis of the interrelation between a number of indicators of the economic (production and transport) and social infrastructure of agriculture and its more complete expression, we will form an adequate system of indicators for the rural production, social and transport infrastructure in Table 3.

Table 3

### AIC Infrastructure Indicators

Effectiveness Indicator	Infrastructure Group	Factor Indicator
Gross output of agricultural products (services), billion KZT	Social	Economically active population - total, thousand people
		Economically active population with higher education, thousand people
		Provision of housing for the population, sq.m. per person – rural areas
		Average monthly nominal wage of one employee by types of economic activity, KZT
		Number of doctors of all specialties, thousand people
		Number of middle medical personnel, thousand people
		Number of hospital organizations
		Number of hospital beds, thousands
		Housing improvements – water supply, %
		Housing improvements – sewage system, %
		Housing improvements – central heating, %
		Housing improvements – Gas (incl.liquid), %
	Production	Number of registered legal entities, units
		Number of fixed telephone lines in rural areas, thousand units
		Agrochemistry production, mln KZT
		Investments in fixed assets by directions of use - Agriculture, forestry and fisheries, mln. KZT
	Transport	Cargo transportation and turnover by mode of transport - all types of transport
		Cargo transportation and turnover by mode of transport - railway
		Cargo transportation and turnover by

		mode of transport - auto
		Investments in fixed assets by directions of use - transport and warehousing, mln KZT

Source: Authors' own preparation

### Methods and data

Specifically for the selected key indicators that determine the infrastructure development of Kazakhstan's AIC, let us examine the hypothesis on the existence of a trend characterizing the long-term basic regularity of the development of the studied phenomenon of the agricultural infrastructure indicators of Kazakhstan.

The hypothesis of the interrelation between the frequency of fluctuations in yields, droughts, precipitation, temperature behaviour, natural abnormal phenomena, investment inflow leading to growth or slowing down of business activity in crop growing and livestock breeding is fully justified. To find such a periodicity means to be able to predict the dynamics processes and to be ready for their occurrence. We believe that the cyclicity as a global approach combining the relationship between retrospective and predictive processes contributes to a deeper understanding of economic phenomena. This provision is acceptable in studying the dynamics of the agricultural sector where the idea of multicyclicity is reasonably applicable. Contributions to the study of agricultural markets, the role of industrial infrastructure in the economic development were made by scientists of the Institute of Conjuncture, created in Russia in the 1920s. The Institute was headed by the Russian N.D. Kondratiyev, the economist, now considered as a representative of the Russian branch of the institutional and social direction in economic science, the investigator of cyclical waves in the economy.

Studies showed that a long wave of economic crises in agriculture can be divided into two half-waves of 30-year duration, where we can identify upward and downward trends within each of these waves. For 30 years, there have been investment flows leading to an increase or a slowdown in business activity in crop growing and livestock breeding; there can be 2 or 3 shifts. Moreover, within the 11-12-year period, the existence of Kitchin cycles connected with the peculiarities of agricultural production is evident [23].

The pattern of cycle manifestation is actual due to the boundary delimitation of the specific features of the cyclical dynamics inherent in the agricultural sector of the particular region, especially for such an agricultural country as the Republic of Kazakhstan with its vast territory. An important role is played by the regional specificity such as geographical features of territorial formations within the country, political decisions of government bodies in various fields, etc. All this make impact on the mechanism of their development. Therefore, it is inadvisable to copy the revealed patterns and tendencies of the economic dynamics from one region to other territories.

Thus, the use of methods to solve the indicated problem in the development of Kazakhstan's agricultural sector from the viewpoint of presence of cyclical fluctuations subject to the influence of random factors is fully justified.

Levels of the series: the time series is divided into two approximately equal parts in terms of the number of members, each of which is regarded as some independent sample having a normal distribution. If the time series has a trend, then the averages calculated for each complex must significantly differ from each other. If the discrepancy is insignificant, unimportant (random), then the time series has no trend. Thus, the verification of the presence of a trend in the series under investigation reduces to testing the hypothesis on the equality of average two normally distributed complexes [19].

The presence of the main trend in the development indices of the AIC infrastructure of Kazakhstan is determined below, based on the time series data, according to the statistical data of the Committee on Statistics of the Ministry of National Economy of Kazakhstan.

For the selected time series, we calculate the mean values and sample variances:

$$\bar{y}_1 = \frac{\sum_{i=1}^{n_1} x_i}{n_1}; \quad S_1^2 = \frac{\sum_{i=1}^{n_1} (x_i - \bar{x})^2}{n_1}; \quad (1)$$

$$\bar{y}_2 = \frac{\sum_{j=1}^{n_2} x_j}{n_2}; \quad S_2^2 = \frac{\sum_{j=1}^{n_2} (x_j - \bar{x})^2}{n_2} \quad (2)$$

$$\bar{y}_1 = 1909; \quad S_1^2 = 122617;$$

$$\bar{y}_2 = 2740; \quad S_2^2 = 163907$$

We check the hypothesis on the equality of dispersion if  $\alpha = 0,05$ .

$$H_0 : \sigma_1^2 = \sigma_2^2, \quad H_1 : \sigma_1^2 \neq \sigma_2^2$$

The F-distribution serves to answer these questions [20].

$$F_{calc.} = \frac{S_2^2 / \sigma_x^2}{S_1^2 / \sigma_y^2} = \frac{163907}{122617} = 1,336$$

When the general dispersions are equal, the calculated value of the F-distribution becomes:

$$F_{calc.} = \frac{S_2^2}{S_1^2} \approx \frac{163907}{122617} = 1.336$$

where  $\sigma_x^2$  and  $\sigma_y^2$  - general dispersions of two samples  $n_x$  and  $n_y$ .

The F-distribution is tabulated.

It is determined by two parameters  $v_1$  and  $v_2$  - degrees of variance.

$$v_1 = n_x - 1; \quad v_2 = n_y - 1.$$

$$v_1 = 3 - 1 = 2; \quad v_2 = 3 - 1 = 2.$$

$$F_{cr}(0,05; 2,2) = 19,00$$

Since  $F_{calc.} < F_{cr} (0,05; 2,2)$ , there is no reason to reject the null hypothesis. According to observations, the variances of general totality are equal,  $\sigma^2_1 = \sigma^2_2$ , the corrected dispersions ( $S_1^2$  и  $S_2^2$ ) differ insignificantly, (the discrepancy between them is accidental). Then we can review the main hypothesis:

$$H_0 : \bar{y}_1 = \bar{y}_2; \quad H_1 : \bar{y}_1 \neq \bar{y}_2$$

$$T_{pacu} = \frac{\bar{y}_1 - \bar{y}_2}{\sqrt{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}} \sqrt{\frac{n_1 n_2 (n_1 + n_2 - 2)}{n_1 + n_2}} \approx$$

$$\approx \frac{1909 - 2740}{\sqrt{(3-1) \cdot 122617 + (3-1) \cdot 163907}} \cdot \sqrt{\frac{3 \cdot 3 \cdot (3+3-2)}{3+3}} \approx 2,986$$

Then we compare  $T_{calc.}$  with the tabulated value  $t_{test} (\alpha, \kappa)$  - the critical point of the Student's distribution.

where  $\kappa = n - 2$  degree of variance,  $\alpha$  - preset level of significance.

$$\kappa = 6 - 2 = 4; \quad t_{test} (0,05; 4) = 2,78$$

Since  $|T_{calc.}| > t_{test} (0,05; 4)$ , then there is no reason to reject the null hypothesis that the time series has a trend, since the averages calculated for each totality, are varied significantly. Hence we conclude that the trend of the indicator “Gross output of agricultural products (services)” is present.

The calculated values of other indicators are given in Table 4.

Table 4

**Development trends of basic indicators of the infrastructure of Kazakhstan`s AIC**

Indicator	$\frac{F_{calc.}}{F_{tabl.}}$	F-test	$\frac{T_{calc.}}{T_{tabl.}}$	T-test	Trend
1	2	3	4	5	6
Gross output of agricultural products (services), billion KZT	$\frac{1,336}{19,00}$	$F_{calc} < F_{test}$	$\frac{2,98}{2,78}$	$T_{calc} > T_{test}$	Present
Economically active population - total, thousand people	$\frac{0,971}{19,00}$	$F_{calc} < F_{test}$	$\frac{0,23}{2,78}$	$T_{calc} < T_{test}$	Absent
Economically active population - with	$\frac{0,488}{19,00}$	$F_{calc} < F_{test}$	$\frac{3,24}{2,78}$	$T_{calc} > T_{test}$	Present



higher education, thousand people					
Provision of housing for the population, sq. m. per person - countryside	<u>1,333</u> 19,00	Fcalc <Ftest	<u>5,345</u> 2,78	Tcalc> Ttest	Present
Average monthly nominal wage of one employee by types of economic activity, KZT	<u>4,269</u> 19,00	Fcalc <Ftest	<u>4,01</u> 2,78	Tcalc> Ttest	Present
Number of doctors of all specialties, thousand people	<u>2,930</u> 19,00	Fcalc <Ftest	<u>5,14</u> 2,78	Tcalc> Ttest	Present
Number of middle medical personnel, thousand people	<u>0,143</u> 19,00	Fcalc <Ftest	<u>1,28</u> 2,78	Tcalc< Ttest	Absent
Number of hospital organizations	<u>29,289</u> 19,00	Fcalc >Ftest	<u>2,95</u> 2,78	Tcalc>Ttest	Absent
Number of hospital beds, thousand	<u>0,628</u> 19,00	Fcalc <Ftest	<u>6,99</u> 2,78	Tcalc>Ttest	Present
Housing improvement - water supply, %	<u>0,011</u> 19,00	Fcalc <Ftest	<u>7,56</u> 2,78	Tcalc>Ttest	Present
Housing improvement – sewage system, %	<u>0,490</u> 19,00	Fcalc <Ftest	<u>8,69</u> 2,78	Tcalc>Ttest	Present
Housing improvement – central heating, %	<u>0,231</u> 19,00	Fcalc <Ftest	<u>1,23</u> 2,78	Tcalc<Ttest	Absent
Housing improvement – gas (incl.liquid), %	<u>0,016</u> 19,00	Fcalc <Ftest	<u>9,69</u> 2,78	Tcalc> Ttest	Present
Number of registered legal entities, units	<u>5,154</u> 19,00	Fcalc <Ftest	<u>5,68</u> 2,78	Tcalc> Ttest	Present
Number of fixed telephone lines in rural areas, thousand units	<u>2,807</u> 19,00	Fcalc <Ftest	<u>0,41</u> 2,78	Tcalc< Ttest	Absent
Agrochemistry production, mln KZT	<u>5,837</u> 19,00	Fcalc <Ftest	<u>5,76</u> 2,78	Tcalc> Ttest	Present
Investments in fixed assets by directions of use - Agriculture, forestry and fisheries, mln KZT	<u>0,867</u> 19,00	Fcalc <Ftest	<u>4,36</u> 2,78	Tcalc> Ttest	Present

Cargo transportation and turnover by types of transport – all types of transport	$\frac{9,430}{19,00}$	Fcalc <Ftest	$\frac{4,70}{2,78}$	Tcalc> Ttest	Present
Cargo transportation and turnover by types of transport – railway	$\frac{13,012}{19,00}$	Fcalc <Ftest	$\frac{5,97}{2,78}$	Tcalc> Ttest	Present
Cargo transportation and turnover by types of transport – auto	$\frac{16,135}{19,00}$	Fcalc <Ftest	$\frac{5,88}{2,78}$	Tcalc> Ttest	Present
Investments in fixed assets by directions of use - Transport and warehousing, mln KZT	$\frac{3,880}{19,00}$	Fcalc <Ftest	$\frac{4,17}{2,78}$	Tcalc> Ttest	Present

Source: Authors' own preparation based on statistical data for Kazakhstan

Results obtained characterize the existence of a general trend in the dynamics of the development of basic indicators of the infrastructure of Kazakhstan's AIC as a whole. In order to reveal the general trend of factors during the analyzed time interval, the time series is smoothed. This is due to the fact that, in addition to the influence of the main factors on the level of the calculated index, there are numerous random factors, thereby causing deviation of levels from the trend. The result of this action is formed with the help of a residual random component [21].

The factor analysis of the interrelation between a number of indicators of the infrastructure of the economic (production and transport) and social development of agriculture shows a definite relationship between the social, production and transport processes in the agrarian sphere (Table 5).

Table 5

**Determining connection between the factors of the infrastructure of economic (industrial, transport) and social development of agriculture**

Result-based feature	Dependence	factor-based feature
Gross output of agricultural products (services), billion KZT	Pair correlation coefficient (R) = 0,59 Determination coefficient (R <sup>2</sup> ) = 0,35 Elasticity coefficient (E)= 1,26	Economically active population - total, thousand people
	Pair correlation coefficient (R) = 0,91 Determination coefficient (R <sup>2</sup> ) = 0,82	Economically active population - with higher education, thousand people

Elasticity coefficient (E)= 9,33	
Pair correlation coefficient (R) = 0,74 Determination coefficient (R <sup>2</sup> ) = 0,56 Elasticity coefficient (E)=1,41	Provision of housing for the population, sq. m. per person - countryside
Pair correlation coefficient (R) = 0,16 Determination coefficient (R <sup>2</sup> ) = 0,03 Elasticity coefficient (E)=1,06	Average monthly nominal wage of one employee by types of economic activity, KZT
Pair correlation coefficient (R) = 0,77 Determination coefficient (R <sup>2</sup> ) = 0,59 Elasticity coefficient (E)=9,33	Number of doctors of all specialties, thousand people
Pair correlation coefficient (R) = 0,26 Determination coefficient (R <sup>2</sup> ) = 0,07 Elasticity coefficient (E)=3,19	Number of middle medical personnel, thousand people
Pair correlation coefficient (R) = 0,78 Determination coefficient (R <sup>2</sup> ) = 0,62 Elasticity coefficient (E)=1,79	Number of hospital organizations
Pair correlation coefficient (R) = 0,75 Determination coefficient (R <sup>2</sup> ) = 0,56 Elasticity coefficient (E)=2,91	Number of hospital beds, thousand
Pair correlation coefficient (R) = 0,57 Determination coefficient	Housing improvement - water supply, %

	(R <sup>2</sup> ) = 0,34 Elasticity coefficient (E)=2,62	
	Pair correlation coefficient (R) = 0,69 Determination coefficient (R <sup>2</sup> ) = 0,49 Elasticity coefficient (E)=0,36	Housing improvement – sewage system, %
	Pair correlation coefficient (R) = 0,76 Determination coefficient (R <sup>2</sup> ) = 0,58 Elasticity coefficient (E)=1,77	Housing improvement – central heating, %
	Pair correlation coefficient (R) = 0,64 Determination coefficient (R <sup>2</sup> ) = 0,42 Elasticity coefficient (E)=13,81	Housing improvement – gas (incl.liquid), %
	Pair correlation coefficient (R) = 0,41 Determination coefficient (R <sup>2</sup> ) = 0,16 Elasticity coefficient (E)=4,45	Number of registered legal entities, units
	Pair correlation coefficient (R) = 0,12 Determination coefficient (R <sup>2</sup> ) = 0,02 Elasticity coefficient (E)=4,23	Number of fixed telephone lines in rural areas, thousand units
	Pair correlation coefficient (R) = 0,79 Determination coefficient (R <sup>2</sup> ) = 0,63 Elasticity coefficient (E)= 0,16	Agrochemistry production, mln KZT
	Pair correlation coefficient (R) = 0,15 Determination coefficient (R <sup>2</sup> ) = 0,07	Investments in fixed assets by directions of use - Agriculture, forestry and fisheries, mln KZT

Elasticity coefficient (E)=1,01	
Pair correlation coefficient (R) = 0,76 Determination coefficient (R <sup>2</sup> ) = 0,58 Elasticity coefficient (E)=3,12	Cargo transportation and turnover by types of transport – all types of transport
Pair correlation coefficient (R) = 0,62 Determination coefficient (R <sup>2</sup> ) = 0,38 Elasticity coefficient (E)= 0,48	Cargo transportation and turnover by types of transport – railway
Pair correlation coefficient (R) = 0,85 Determination coefficient (R <sup>2</sup> ) = 0,73 Elasticity coefficient (E)=3,49	Cargo transportation and turnover by types of transport – auto
Pair correlation coefficient (R) = 0,16 Determination coefficient (R <sup>2</sup> ) = 0,03 Elasticity coefficient (E)=1,02	Investments in fixed assets by directions of use - Transport and warehousing, mln KZT

Source: Authors' own preparation based on statistical data for Kazakhstan

## Results and Discussion

The results of the factor analysis show a fairly close relationship between the levels of the economically active population, those with higher education, provision of the population with housing in rural areas, number of doctors of all specialties, number of hospital organizations and number of hospital beds. A significant level has been achieved in improving the housing stock with the availability of water, gas and central heating, sewerage, as well as the indicators of agrochemical production, transportation of goods and freight turnover by mode of transport (road, rail).

As a resulting indicator we took “Gross output of agricultural products

(services), billion KZT”.

Between the factor-based indicator “Economically active population - total, thousand people” and the calculated result-based indicator, there is both a connection and influence, with the coefficient of determination of 0.35 and the value of the coefficient of pair correlation of 0.59. The coefficient of elasticity shows that the result-based indicator will increase by an average of 1,26% when the factor-based indicator changes by 1%.

A very close relationship is observed between the result-based and factor-based indicators - the area of rural living quarters, with sewage, water, gas and central heating. The calculated coefficients of pair correlation were 0.69, 0.57, 0.64 and 0.76 respectively. Estimated result on the factor-based indicator “Cargo transportation and turnover by mode of transport – motor transport” showed the value of the coefficient of pair correlation is equal to 0.85 which indicates a very high interaction with the result-based factor.

The value of the pair correlation coefficient by factor-based feature “Provision of housing, sq. m. per person - the countryside” was 0.74, and the coefficient of determination was 0.56, which indicates a fairly strong connection with the result-based factor. Thus, with an increase in the factor of housing provision by 1%, the indicator “Gross output of agricultural products (services)” gives an increase of 1.41%.

Thus, the analysis shows that the change in the factors of the economic bloc is reflected in the values of the social bloc factors.

The analysis of the dependence of the factor “Gross output of agricultural products (services)” on the indicator describing the health care system through the factor “Number of hospital organizations”, by means of multiple correlation gave the coefficient of determination equal to 0.62. This figure indicates that there is a direct relationship between the factors being evaluated, i.e. 62% of the change in the result-based indicator depends on this factor.

The dependence of the average annual production of agricultural products per one rural resident on the indicators that characterize the education system is further evaluated according to the same algorithm.

The resulting coefficient of determination ( $R^2 = 0.82$ ) indicates that there is a direct and close relationship between the selected factors characterizing the impact on the AIC development of the higher education system, and 82% of the change in the result-based indicator depends on this factor.

The results of multiple correlations showed the dependence of the factor “Gross output of agricultural products (services)” on indicators characterizing the education and health system:

- increase in the level of education of the economically active population, coverage with educational services and increase in the capacity of medical outpatient and polyclinic organizations will lead to an increase in the gross output of agricultural products (services) for the level of the calculated elasticity coefficient of 9.33 and 1.79 respectively.

Calculations show that raising the level of education significantly affects the quality of human capital - the main factor in multiplying the wealth of society, which determines the growth of social productivity. The level of education characterizes the accumulated educational, scientific, labor, creative and intellectual potential that makes up the pool of cumulative knowledge and skills - the “spiritual wealth” of society. This quality is transmitted from generation to generation and thus represents an important prerequisite for both the development of the person himself and the growth of the effectiveness of the reproduction process as a whole.

Based on the data on the costs and the number of years of education provided by the state, family, organizations and enterprises, it is possible to track the accumulated potential of knowledge for a certain time period. This circumstance will fully apply to the cultural level of society, i.e. the higher the spiritual development of a person, the more qualitative and rich the person’s life is. For this purpose, in order to identify the qualitative characteristics of indicators of the spiritual development of society, indicators that reflect the degree of education and cultural development of society are proposed.

To determine the characteristics of satisfaction of social needs, it is proposed to use both the indicators available to date and the addition of new ones.

Thus, to characterize working conditions it is suggested to use indicators such as the number of people injured at work and the number of people injured at work with a fatal outcome (per 10,000 people working). Characterization of the conditions of rest is proposed to be assessed with two quantitative indicators: the number of Kazakhstanis who have rested in the estimated period and one indirect indicator that characterizes the tourist attractiveness of Kazakhstan.

Thus, it is obvious that there is a direct quantitative relationship between the level of development of the social infrastructure of rural areas and the results of agricultural production.

The development of social infrastructure determines the level of comfort for the population residing on the territory of the region, provides social stability, promotes the consolidation of the population, the inflow of entrepreneurial structures, determines the level of the territorial competitiveness. This corresponds to the modern view of M. Porter's competitiveness.

The performed research provides an opportunity to assess the level of development of the infrastructure of municipal rural areas through the integrated complex factors, to identify the necessary growth points for targeted impact on performance indicators: improvement of population conditions and growth of agricultural production.

Development and practical application of research tools provide the opportunity to manage social processes. Based on the analysis of empirical materials, the substantive part of the interrelation between agricultural production and social infrastructure has been determined. It was established that there is a direct correlation between the level of the social infrastructure development in rural areas and agricultural production. The results of the analysis showed that the social

infrastructure facilities in the region are disproportionately dispersed in the municipal districts. General trends in the development of the economy and the social sphere of the Republic of Kazakhstan are characterized as consistently positive.

The performed studies on the mutual influence of the social infrastructure of the village and directly on agricultural production made it possible to identify a number of problems and to determine the directions of work on their solution; such directions are as follows: to develop the social infrastructure serving the population households, since this sector produces about 52-54% of all production in the country; to develop the infrastructure of a territorial microcluster; to establish the interaction between the entities of the territory of a particular rural settlement or a municipal district; to establish the infrastructure of public-private partnership in personnel training and ensuring the population employment. This is especially important in coordinating the actions of government bodies, educational institutions, consumers and sellers in the labor market. To develop the infrastructure ensuring the adaptation of young people to the agricultural labor market and the prevention of young people outflow; in the region there is a need for creation of servicing agricultural consumer cooperatives due to the fact that the existing infrastructure does not meet the needs of private subsidiary farms in operation servicing.

When working as part of a cooperative of citizens who run a subsidiary farm, the costs for cultivating land and fodder conservation will be reduced by 20%; the development of relations between the households of the population and market institutions within the framework of a food microcluster will increase the agricultural producer's share in the final product price from 35 up to 60-70% and the share of domestic food products in the market up to 70% due to the development of the sales system; increase the production cost up to 40% when it is sold off-season with the creation of its own transport and storage network; reduce transaction costs to 30%, expanding the network of information and consulting services and access to Internet resources. To ensure revenue growth up to 20% with the establishment of independent organizations engaged in determining the quality of agricultural products.

When creating an operating mechanism for public-private partnerships, the following results can be obtained: coordination of efforts in development of the regional labor market and improvement of the adaptation processes thereon; provision of private-state partnership in the field of training of highly qualified and highly demanded personnel for the agroindustrial complex; information support for participants in the partnership; creation of an innovative educational infrastructure in favor of educational institutions of various levels in agricultural training profile. The need for provision of the country's food security in the context of Kazakhstan's accession to the WTO puts forward the creation and the development of social infrastructure institutions in the food market system of the megapolis as a priority. The creation of a coordinating structure in departments of the city economic policy of the megapolis administration will allow to weaken the contradiction of economic interests of trade networks, raw material processors, and agricultural producers in the region. This can be achieved by concluding agreements when using the capacities of the



commodity distribution infrastructure of trade networks and wholesale and retail trade capacities available in the regions. Thus, methodological and practical recommendations are in demand for the region.

It follows from the analysis that the change in factors of the economic bloc is reflected in the social bloc factor values.

## **Conclusion**

The results of the analysis showed that the objects of social infrastructure are located on the territory of the country in a non-integrated way to a large extent.

In this regard, there is a stratification of the social well-being of rural areas and the villagers living there. The most developed and evenly developing areas are those adjacent to large cities and regional centers.

In general, common trends in the development of the economy and the social sphere of the country's agricultural sector can be characterized as positive, but there is still no sustainable level of development of social, food, transport infrastructure, which affects the quality of life of the population in rural areas.

The study revealed that at present the level of provision of Kazakhstan's agriculture with the objects of social and industrial infrastructure remains in an extremely unstable state, which can form a trend for the decline and degradation of the Kazakh village, and, as a result, lead to the disruption and the decline of reproductive processes in AIC. Therefore, the creation and the development of infrastructure is seen as a prerequisite for effective interaction between subjects of the main and auxiliary industries, ensuring the creation of common preconditions for the development and the growth of agroindustrial production, which in turn will contribute to solving food security problems.

All of the above explains the need for state participation in investment support for social, production and transport development of the village, which in modern conditions should be aimed not so much at increasing individual quantitative indices of agricultural production, but at the ability of the agrarian sector to expand reproduction, to achieve better satisfaction of social needs and quality of life of the rural population as a whole, preservation and augmentation of infrastructure.

In modern conditions, for the solution of the above tasks, it is necessary to point out the importance of strategic management. Discussions on the problems of strategic adaptation of organizations have been held for a long time, especially for non-profit organizations that are characterized by a low degree of influence on the leadership changes, ignoring strategic changes [21].

The further development of the infrastructure depends on the improvement of state policy in the countryside and on the development of modern strategies of the agricultural cooperative organizations, the revival of the entrepreneurial spirit in the countryside in the context of globalization and the internationalization of economic processes [22].

An important step is the entry of agricultural enterprises into international

markets, which increases the importance of the work of economic security services, which in turn is due to the availability of qualified personnel, computer systems for working with databases, etc. According to American researchers, the economic security service at the enterprise passes certain stages [23].

Among equally important tasks, there is identification of technologies critical for the country, which are the forces of national economic development and security [24]. The low share of innovations, the lack of mechanisms to stimulate their development and implementation hinder the development of the agricultural sector, lead to a backlog of world scientific and technological progress, and exacerbate destructive trends in production and consumption [25].

Improving the efficiency of the food market, and therefore solving the problems of ensuring food security depend on the development of both the social and industrial infrastructure of rural areas, and thus the accelerated introduction of innovative technologies. In turn, the increase in business activity of organizations including agrarian ones depends on the development of the institutional structure of the regional agro-food market, as this leads to a reduction in transaction costs [26]. According to J. Wallis and D. Nort, the share of the transactional sector in the US grew from 26% of GNP in 1870 to 55% of GNP in 1970, but transaction costs per unit of national product decreased particularly because of the outstripping growth of the state transaction sector [27].

The development of the infrastructure of rural areas will be facilitated by improved institutions of ownership of land for agricultural purposes, the contract system and the development of the institution of competition.

Improving the infrastructure will contribute to the recovery of the agricultural sector, which is especially important for domestic food market stabilization and food security which are the most important conditions for the sustainable development of the entire economy of Kazakhstan.

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