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The efficiency of the agricultural economy digitalization

Abstract

Object: Based on the analysis of the current economic state of agricultural development in the country and the level of use of digital factors, the degree of influence of the processes of agriculture digitalization on its efficiency was determined, the main problems of their implementation and development were assessed.

Methods: Economic and statistical methods: comparison and correlation methods, logical and analytical methods.

Results: An assessment of the main indicators development level of the country's agricultural activity, as well as the digital factors use level were given. Using correlation analysis methods, the degree of connection between the parameters of agriculture and the industry digitalization level was determined, a regression model was compiled with a predictive estimate of the next year parameters. Specific examples of the digital technologies use and the main problems in this area were considered.

Conclusions: The study showed that the digital factors used in the country have a positive effect on agricultural performance indicators and have a high impact potential. However, currently in our country, it is insignificant, hardly noticeable and this process is not systematic, fragmented in terms of geography of application.

Keywords: digitalization, agriculture, efficiency, digital technologies, correlation, precision farming, digital factors.

Introduction

Digitalization in agriculture is the implementation of a set of measures aimed at automating all stages of the processing of farm products with the participation of stakeholder organizations and administrations. There related to value increase and development of the agricultural industry. Digitalization makes it possible to monitor and supervise the entire life cycle of agricultural products, and quantitative and qualitative assessment of production, and costs. The introduction of traceability and transparency systems ensures a direct focus on a specific market to attract investments in the industry and to create an export-oriented range of agricultural products, to do a quality evaluation of agricultural production. The introduction of comprehensive control using supervisory systems will increase the quality standards of the products of the agro-industrial complex and thereby have a synergistic effect to increase the competitiveness of Kazakhstani agricultural products in foreign markets. To introduce the process of "precision farming" on a number of farms, a pilot project is being implemented using meteorological stations. Based on the pilot project results, the cost-effectiveness of the widespread use of "real farming" will be determined.

Literature Review

Against the backdrop of the rapid development of digital technologies in almost all areas of human activity, there is currently a rapid growth of scientific research and publications in the field of digitalization of the economy of rural areas. In this area, one can name the works of such Kazakhstani scientists as Ahmet D.M., Bukatov S. such Russian researchers as Trufljak E.V., Kurchenko N.U., Magomedov A.M. as well as foreign scientists Benyam A.A., Debauche O., Hafeez A., Jerhamre E., Jones J.W., Mishra S.K., Namani S. They considered the theoretical and methodological aspects of the use of digital technologies in rural areas. At the same time, they tried to show the high importance of digital factors, and also paid great attention to the evolution of the digitalization process of the agro-industrial complex.

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Most of the current research is aimed at characterizing new farming methods, such as “smart farms” (Jerhamre, Carlberg, & van Zoest, 2022), “cloud technologies” (Debauche et al., 2021; Hafeez et al., 2022), “precision farming” (Jones et al., 2017; Benyam, Soma, & Fraser, 2021; Odintsov Vaintrub et al., 2021), etc., while these studies are mostly descriptive, indicating how these technologies work, what are their benefits and areas of application. Nevertheless, in our opinion, these works poorly describe the opportunities and currently existing barriers in the countryside for the introduction of these technologies for a specific production. Thus, despite the relatively large number of scientific publications and publications related to the digitalization of agriculture in recent years, some issues that have not been studied sufficiently. These include issues related to determining the quantitative dependencies of digital factors and performance indicators of rural enterprises, as well as assessing the correspondence between the impact potential of these technologies and the possibilities of their implementation in rural areas in specific economic conditions (Namani & Gonen, 2020). This justifies the relevance of the chosen research topic.

Methods

Since agriculture is one of the most important sectors of the economy of Kazakhstan, contributing to the growth of the country’s economy, ensuring food and economic security, as well as the labor potential of the state, especially in rural areas, it becomes necessary to address the above issues. Covering 1/10 of the country’s GDP, whose products account for more than 50% of all trade in goods, it has a great impact on improving the well-being of the population. The sector is of great importance for our country as well. Despite the positive dynamics of the agricultural industry, the volume of gross production has a gap between the growth rate of consumption and the income of the population and maintaining a low level of labor intensity and competitiveness of agricultural products does not allow increasing production volumes. This leads to the import of products to the domestic market of Kazakhstan. At the same time, Kazakhstan’s membership in the WTO significantly complicated the situation for the competitiveness of agriculture in foreign markets.

From the experience of developed countries, such as the United States, Canada, and Australia, the digitalization of agriculture acts as a disruptive technology and significantly changes this traditional industry. Big data aggregated from different sources, such as geo-information systems and IT, makes it possible to increase benefits with minimal damage to the soil and use resources rationally. The Internet has allowed to create smart farms managed using remote technologies, fully automating the process of growing plants. Modern logistics technologies combined with e-commerce enable a reduction of the cost of delivery of agricultural products and provide more efficient supply chains to the end consumer, even for small farms, while maintaining its quality. The health of the nation comes to the fore and environmentally friendly products are important in this matter which the Republic of Kazakhstan can use to create an export-oriented brand.

At the same time, having great advantages, digital technologies in agriculture of the Republic of Kazakhstan are not sufficiently introduced among agricultural producers, this limits the growth of competitiveness. A big problem is the fact that agricultural land is often underutilized, sometimes misused. This makes it difficult to analyze land use, short-term and long-term forecast of the state of use, and many other issues related to monitoring. In addition, the large spread of the territory of the Republic of Kazakhstan complicates the process of collecting information and monitoring land. Digital technologies are designed to solve a number of problems in this area. Therefore, the digitalization of agriculture is of great importance for the Republic of Kazakhstan, and the programs for introducing digital technologies will improve the quality of the agricultural economy and ensure the profitability of this industry.

The purpose of the study is to address a number of issues related to the development of the agro-industrial complex in Kazakhstan through the use of the latest technologies of the digital industry and the analysis of opportunities to increase the efficiency of their application in the current conditions of the development of agriculture in our country.

The main objectives of this study stem from the consideration and search for ways to solve the main problems facing the desire to introduce new digital technologies in the production and non-production areas of the agricultural industry. These include the following:

The first problem is the availability of equipment from the times of the USSR in Kazakhstan and its low efficiency in the agro-industrial complex. For example, due to a shortage of new equipment, outdated equipment causes a loss of 14 percent of grain and oilseeds during the sowing and harvesting of seeds. At the same time, this direction requires a lot of manual labor, and the problem of increasing the volume of production arises.

Secondly, such problems in animal husbandry as fattening, increasing productivity, loss of livestock. According to statistics, over the past 3 years, 70 percent of the loss of livestock was due to improper control. The direct way to achieve this goal is the automation of agriculture in the country and the complete digitalization of the industry.

Thirdly, weather forecasting in agriculture, determination and control of crop growth rates. The ongoing work in this direction will not only increase productivity but also improve the quality of agriculture in the Republic of Kazakhstan.

Fourthly, the sale and delivery of agricultural products to consumers at no additional cost and affordable prices.

The agricultural complex of the Republic of Kazakhstan is considered an object of study.

The materials are the regulatory legal acts of the Republic of Kazakhstan, the data of the National Bureau of Statistics of the Agency of the Republic of Kazakhstan, special literature and periodicals on the problem under study, materials from Internet resources, information on the official websites of the regions of Kazakhstan, the authors' own research. During the study, economic and statistical methods were used, in particular, comparison methods, correlation and regression analysis, and logical-analytical methods.

Results

Digitalization can have a strong impact on the economy of any country. In the last decade, the whole world has been striving for a new type of economy based on digital technologies. We are witnessing the fact that in a market economy it is significant to use the latest examples of scientific and technological progress to be highly competitive. To improve product quality, maintain a high level of productivity, reduce the cost of goods and services, digital transformation has a huge impact. At present, the basis for the transition of the state to digital development is the widespread use of information technologies in its activities, whether in the private sector or the public sector. Leading world experts predict that by 2022 the world economy will switch to digitalization by 35%, and the process of introducing new equipment and technologies in large volumes will be carried out. Therefore, Kazakhstan, to keep up with developed countries, is moving to the use of digital technologies in all sectors of the national economy.

According to a study by the Boston Consulting Group (BCG), Kazakhstan ranks only 50th among 85 countries in terms of the level of digitalization of the economy (Akhmet, 2020). Because our state is just beginning to study the impact of new equipment and technologies, especially in the field of the agricultural complex, and is gradually introducing them into domestic production. The current situation on the implementation and use of digital methods shows so far little positive developments in this area. However, the agricultural industry is one of the priority, promising sectors of the country's economy. The development of agriculture is objectively determined by the need to form new effective infrastructural links of the digital economy and provide the population with the food of the right quality in the required quantity.

Discussions

The main directions of the implemented measures of the agriculture digitalization program are the increase in crop productivity and labor productivity, the preservation of the country's food security.

The development and introduction of elements of real farming in all regions of the Republic of Kazakhstan is envisaged to simplify activities in the sector, increase crop productivity and labor productivity.

The producer gets the opportunity to make decisions based on the range of received data on the state of crops, moisture, nutrients, nitrogen, potassium, phosphorus, pests, and possible precipitation in real time. At the same time, the introduction of elements of precision farming will be carried out in a complex manner, depending on the acquisition of new agricultural equipment, the implementation of agricultural technologies and the training of farmers. Along with the creation of new and development of existing state information systems in the Kazakhstani agro-industrial complex, the requirement for the creation and implementation of automated systems in the agricultural formations themselves is mandatory and important. Because of such trends in 2019 the profit from agriculture increased the republican GDP by 4 trillion tenge. Animal husbandry annually brings 2 trillion tenge of profit to the state budget. Also, this industry showed growth this year by 3.6%.

The digitalization of the agricultural sector is of great importance in the development of the agro-industrial complex. In particular, one of the areas of digitalization launched in 2017 is the process of "smart" technology. In this regard, to digitalize the agricultural economy, the state program for the development of the agro-industrial complex of the Republic of Kazakhstan for 2017–2021 was adopted, in 2018 - "Agriculture digitalization program: E-APK", "Digital Kazakhstan". When conducting studies of the country regions

on the basis of these programs (Adilet, 2018), one can observe the following picture. For example, in 2020, compared to 2019, the volume of gross agricultural output increased by 23% and amounted to 6.3 trillion tenge. Table 1 presents the overall picture of changes in the main indicators of agriculture.

Table 1. Main indicators of agriculture over the past 8 years

Indicators	Years								Growth rate during 8 years, %
	2013	2014	2015	2016	2017	2018	2019	2020	
Meat (in slaughter weight), thousand tons	871,0	900,2	931,0	960,7	1 017,6	1 059,4	1 120,6	1 168,6	34,2
Milk, thousand tons	4 930,3	5 067,9	5 182,4	5 341,6	5 503,4	5 686,2	5 864,9	6 051,4	22,7
Eggs, million pieces	3 896,0	4 291,2	4 737,0	4 757,2	5 103,0	5 591,4	5 531,4	5 065,8	30,0
Grain yield, centner per hectare	11,6	11,7	12,7	13,5	13,4	13,5	12,3	12,8	10,3
Potato yield, center per hectare	181,5	184,3	185,5	190,4	194,2	197,9	203,4	206,7	13,9
Oilseed yield, centner per hectare	8,0	7,8	8,1	9,6	9,7	9,7	9,3	9,5	18,8
Livestock of cattle, heads	5 851	6 033	6 184	6 413	6 764	7 151	7 436	7 850	34,2
Livestock of small cattle, heads	17 561	17 915	18 016	18 184	18 329	18 699	19 156	20 058	14,2
Note – Compiled by the authors based on the Bureau of National statistics									

According to Table 1, in general, there are positive dynamics of the main indicators of the village over the past 8 years. Significant growth rates are observed for meat, eggs, milk; as well as an increase in the number of cattle. The total gross output in agriculture is also steadily growing, both in crop production and in livestock, as can be seen in Figure 1. Both in crop production and livestock production, there is an increase in production by more than 2 times.

This growth is not a consequence of the introduction of only digital factors. To a greater extent, this is a consequence of the increase in the cost of agricultural products, the use of highly productive seeds, the introduction of minerals, and the extensive increase in the main factors of production. The use of digital methods in production or the management of an agricultural enterprise is at the initial level and still makes a relatively small contribution to the activity. To determine the degree of influence of rural digitalization on changing the main parameters of agriculture, we will try to select indicators of the use of digital technologies that are more or less responsible for the activity of their use in work.

First of all, this is an indicator of the number of expenses of rural enterprises for the introduction of information and communication technologies, since it is this parameter that determines the activity of enterprises to use digital methods in their work.

The volume of information technology use implies an increase in demand for specialists in this field who could use these technologies. Thus, the number of high-tech specialists is also important for analysis.

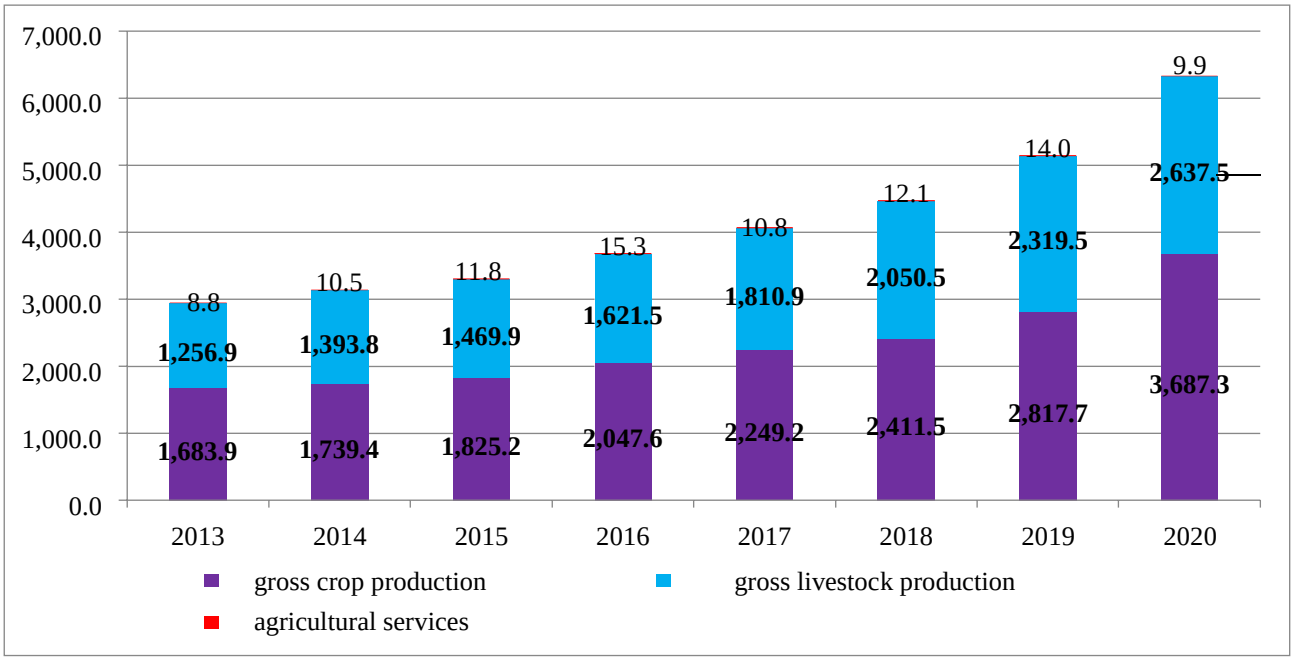

Figure 1. Dynamics of gross output of agricultural production, billion tenge

Note – Compiled by the authors based on the Bureau of National statistics

Separately, one can consider such parameters as the equipment of rural enterprises with computer equipment, and an Internet connection, as well as the number of firms using computer equipment, Internet portals and websites, as well as the number of enterprises using new digital technologies, in particular cloud technologies that have begun to be applied since 2016.

These parameters are presented in Table 2.

Table 2. Indicators of digitalization in agriculture of the Republic of Kazakhstan

Indicators	2013	2014	2015	2016	2017	2018	2019	2020
Number of enterprises using computers	1 624	1 706	1 786	2 389	2 252	3 573	3 893	4 375
Number of enterprises using cloud technologies	0	0	0	19	102	162	193	288
Number of enterprises using Internet portals	310	469	639	1 041	1 155	1 748	2 127	2 388
Number of computers with Internet	5 174	6 212	5 438	8 912	9 637	10 501	12 054	13 425
Number of IT specialists, persons	188	192	120	403	312	156	238	195
Expenses on ICT technologies, million tenge	539	601	480	743	947	949	1 027	1 421
Note – Compiled by the authors based on Bureau of National statistics								

It can be noticed from Table 2, the parameters of digitalization are growing at a high pace from year to year. Thus, the use of computer technology has increased almost three times, Internet portals have been used seven times more, the costs of information and communication technologies have increased almost three times. Only the number of specialists in the field of computer technology, having increased in 2016 to 403 people, again decreased to 195 people, which was the result of low wages and high staff turnover in the countryside.

Despite the positive dynamics of the parameters, if they are analyzed in absolute measurement and in comparison with general indicators throughout the economy, then one can see a weak level of implementation of digitalization elements in the countryside. For example, spending on information and communication technologies over the past year amounted to 1.4 million tenge, which is only 0.37% of the cost of these technologies throughout the country (389 million tenge). The same can be seen in other parameters. This means that the agriculture of our country is currently weakly implementing digital methods.

To assess the impact of digital parameters on the efficiency of agricultural production, let us try to determine the degree of connection between the dynamics of their changes and the dynamics of the total gross output of the village (Table 3).

Table 3. Matrix of pair correlations between the parameters of digitalization and gross rural output

	1	2	3	4	5	6	7
The volume of agricultural production, billion tenge	1						
Enterprises using computers	0,9572	1					
Enterprises using cloud technologies	0,9802	0,9617	1				
Computers with Internet	0,9497	0,9480	0,9422	1			
Number of specialists	0,0021	-0,0298	-0,0774	0,2283	1		
ICT spending, million tenge	0,9678	0,9109	0,9650	0,9612	0,1319	1	
Firms using the Internet	0,9677	0,9876	0,9645	0,9746	0,0446	0,9293	1
Note — Compiled by the authors							

As can be seen from Table 3, there is a good correlation between the dynamics of digital indicators and the gross volume of agricultural production (over 0.9), except for the parameter of the number of specialists, where the relationship is very low, almost imperceptible. The reason is the specificity of this work and the presence of highly paid demand for this category of specialists.

Based on the obtained data, it is possible to determine the regression equation between the specified parameters and the performance indicator (Table 4). The possibilities of the Excel program were used in the calculations.

Table 4. Regression analysis results

Indicators	Coefficient	Determination coefficient	Number of Observations
Free term of the equation	2 822,77	0,994	8
Number of enterprises using computers	-0,144		
Number of enterprises using cloud technologies	-3,895		
Number of computers with Internet	-0,665		
Number of IT specialists	1,429		
Expenditure on ICT technologies	4,911		
Number of firms using Internet portals	2,893		
Note — Compiled by the authors			

It was found that the coefficient of determination or R-square is 0.994. This means that the calculated parameters of the model explain the relationship between the studied parameters by 99.4%. This is a high parameter and means the high quality of the presented model. Based on the calculated coefficients of the regression equation, we will compose an equation for our model. It will be equal to:

$$Y = 2822,7 – 0,144X1 – 3,895X2 – 0,665X3+1,429X4+4,911X5+2,893*X6$$

The equation shows that to increase the volume of gross agricultural output, more attention should be paid to such parameters as an increase in the cost of information technology, the number of IT specialists and the number of firms actively using Internet technologies. The number of computers, the number of firms using cloud technologies and computer technology are not particularly important for agricultural performance.

If we accept the growth dynamics of digital indicators in 2020 compared to 2019 and the next year 2021, we can predict the size of the gross agricultural output for this year. It will be equal to:

$$Y = 2822,7 – 0,144*4917 – 3,895*430 – 0,665*14952 + 1,429*160 + 4,911*1966 + 2,893*2681 = 8131,3 \text{ (billion tenge)}$$

Thus, according to the regression model, the volume of gross agricultural output will increase by 28.4%, which is a high parameter for the growth of economic indicators. Such growth due to the indicated increase in the level of digital parameters is impossible, since the share of the impact of the considered indi-

cators in the total number of agricultural factors is currently insignificant. The resulting figure only shows the mathematical-statistical interaction of the parameters. However, in any case, using the example of the regression analysis carried out, one can be convinced of the importance of digitalization in the industry and its positive impact on the efficiency of rural producers.

Since 2019, such a new parameter as the use of digital technologies in production has been added to the statistics of information and communication technologies. We believe that this is a positive moment and this indicator will allow us to more accurately determine the degree of influence of the digital technology factor on the activities of firms.

Over the past two years, this parameter throughout the country amounted to about 2,500 firms that actively used digital technologies in production, in particular, about 50-60 firms in rural areas, or about 2–2.5% of the total. This small figure also indicates that digitalization in our country is still insignificant and fragmented. There is an important task for the economy and the authority of our country to give this process a systemic character.

As mentioned above, the introduction of digital methods is still fragmentary, low in volume and uneven, and therefore the effectiveness of using these methods can be seen from individual examples through the reflection of some of the results of digitalization in certain regions of the country. For example, in Kostanay region, within the framework of the digitalization of agriculture program, in the Kamysty village, "PKF Kairat" LLP began to apply the method of precision farming, which gave a practical result in the form of savings in production costs in the amount of 15%. And in the Fedorovsky district, "Troyana" LLP in spring sowing, using 4 satellite navigation units, sowed 6.4 thousand hectares, saved 10 million tenge on sowing seeds, fuels and lubricants, fuel resources, protective equipment. If these examples are reflected in the size of the whole region, the annual economic effect could reach tens of billions of tenge.

In Pavlodar region, 870 million tenge was received from the digitalization of seven agricultural enterprises, the costs of treatment facilities and crop protection equipment, fuel and energy materials decreased by 2 times. And on the introduction of precision farming elements from 1 hectare, an additional 500 kilograms of the crop was obtained, i.e. the average yield on the farm increased from 17 centners per hectare to 22 centners per hectare. Another example is that in the largest agricultural holding in the region, "Olzha Agro" LLC, all grain harvesting equipment is equipped with "friend or foe" technology (Bukatov, 2020), which ensures the safety of grain and control over its movement.

In the East Kazakhstan region, two digital crop production projects are being implemented. The first project is called "Introduction of IT-technologies for the efficient use of land". This is an experimental oilseed farm in the village Solnechnoye, Glubokoe district, and farming in the village Saratovka, Ulan district. The second project is "Introduction of sustainable farming technologies to increase the yield of fodder crops in the field areas". It is implemented by the farms "Lana", "Ertay", "Balke" of the Beskaragay region.

According to Trufliak, Kurchenko, & Kreimer (2019), precision farming is an integrated agricultural production system based on the achievements of information technology, the use of an automatic control and regulation system for tractors and agricultural machines and equipment, sensor technology and general computerization of all agricultural management processes and aimed at optimizing agricultural technologies and stabilizing the productivity of agrocenosis with minimal negative impact on the environment.

In this regard, the Information Technology Center was opened in the East Kazakhstan region in the office of the regional government. According to the principle of the above-mentioned precision agriculture, the main goal of the center is to create electronic field maps to increase the economic efficiency of crop production, develop economic models for the introduction of technologies for farms of various types as part of the introduction of elements of precision agriculture, including accurate meteorological data, sensors and space monitoring, and other solutions, providing the process of digitalization of the region as a whole.

Especially important for ensuring rapid and comprehensive digitalization in the country is the development of the activities of educational institutions and research institutes, as well as pilot farms for the study and practical application of digital technologies. No less important is the establishment of close cooperation between these development institutions and the business environment, because the introduction of such technologies can increase production efficiency by an average of 15% due to accurate seeding, differential insemination, and reduction of protective equipment and costs.

There are examples of the use of advanced technologies in animal husbandry. From year to year the demand for meat and meat products is growing. The solution to this problem is impossible without direct processes of digitalization and automation. One of the new trends is automated sites for the creation of marbled veal steak. This process is carried out using radio frequency identification, in which a special RFID tag

is hung on experimental oxen. This tag hangs on the animal's neck during the period from the beginning of the fattening process to the sale of meat. Through it, it is taken into account how much weight the cattle add daily. Here, along with the daily ration, one can also get information about which veterinary examination the livestock has undergone. Therefore, such a digital process increases the economic efficiency of animal husbandry and simplifies its calculation. The main result of the digitalization of agriculture is an increase in labor productivity and a reduction in costs.

Thus, in many regions of Kazakhstan, electrification of a beef cattle fattening farm is being carried out. Feeding sites with a capacity of 14 thousand heads in Aktobe region, 10 thousand heads in Karaganda region, 8 thousand heads in Kostanay region, 45 thousand heads in Akmola region, 39 thousand heads in Almaty region have already been launched and are operating.

As for individual farms, then in Kostanay region, "Saryagash" LLP has installed electronic bracelets for milking cattle, monitoring the health and productivity of animals. Under the "Sybaga" program, 62 800 thoroughbred bulls were produced. If in 2019 the net weight of a bull was 344 kg, then by 2022 it is planned to increase this figure to 500-600 kg. Thus, it is possible to increase the number of cattle to 1 million heads and increase the area of pasture land to 10 million hectares. In animal husbandry, by 2022, it is planned to create 166 advanced farms and one digital farm. Now basic farms with an information-analytical system are being created. To date, eight dairy farms have implemented Smart Farm elements.

There are also positive results in East Kazakhstan region, because of digital technologies, the amount of milking milk from 6 thousand cows on farms has been increased by one and a half times. By 2022, digital equipment will be installed on seven more farms. New technologies are used in the meat farms "Shalabay", "Sembell", "Elimay-Kokpekty", "Ykybay", "Nur".

An automatic system for recording livestock was launched in Turkestan region. The advantage of this system is that it allows you to control the grazing movement of livestock and check which veterinary activities have been carried out.

One of the ways to comprehensively address the digitalization of agriculture is the digitalization and replacement of machinery and equipment used in agriculture with modern technology. This is a relevant problem (Informburo, 2018), since at the moment the technical park of agriculture is outdated, which reduces labor productivity, hinders the increase in production efficiency, increases the level of use of fuels and lubricants, and negatively affects the quality and volume of products. In this regard, for the modernization of agricultural machinery in our country, on our own experience, advanced technologies of foreign producers are used.

One of the proofs is the use of intelligent technology in the West Kazakhstan region, which is automatically controlled and operates 24 hours a day, which increases productivity by 18% and reduces costs by 11%. On the territory of the West Kazakhstan region, 12 advanced farms are implementing this new system. The advantage of this system (Magomedov, 2020a & Magomedov, 2020b) is that with a differentiated method of applying fertilizers, i.e. when sowing seeds on barren soils, unproductive lands, fertilizers are sown in large volumes, and on fertile and high-yielding lands - in smaller volumes.

The most important role in the digitalization of rural areas belongs to the development of rural e-commerce. This conceals huge reserves for the development of rural areas.

Thus, the analysis of the results of the introduction of digital methods into the practical activities of the enterprise showed that these measures have a tangible effect, but the size of these activities and the volume of investments at the current time are small and are of little significance in the country as a whole. We consider the following to be the main reasons for such a small volume of digital technologies introduction in agriculture:

– lack of information awareness of agricultural producers about the availability, possibilities, and effectiveness of digital methods;

– low level of digital literacy of the population (especially rural), which leads to a low starting level of digitalization (in most rural enterprises, computers are used only for office or accounting needs);

– the high cost of digital technologies, the lack of financial resources of rural entrepreneurs due to the seasonal nature of production, the lack of free working capital, etc.;

– a small number of large agricultural formations that have more production and financial opportunities when introducing digital methods;

– low communication between scientific and educational institutions and agricultural producers, etc.

Conclusions

Based on the study, the following conclusion can be drawn. Modern information technologies help to improve the efficiency of agricultural production. Statistical analysis of the impact of digital factors on the performance of rural enterprises confirmed their positive impact and high correlation with the resulting parameters. The analysis also showed that, unfortunately, the innovations of the agro-industrial complex in Kazakhstan are practically not developed. The use of these technologies is insignificant and fragmentary in nature. Measures are being taken in some regions, there are specific firms that actively use the latest technologies that prove their viability and effectiveness. However, these measures, for various reasons, are single and uneven. To achieve high development efficiency, it is necessary to create various programs for improving the digital skills of personnel promoting and developing agricultural production. Summarizing the above, it can be noted that the digitalization of agriculture is beginning to emerge in our country, and the further development of agriculture in the country and regions will depend on the level of application of digital production methods.

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Ауыл шаруашылығы экономикасын цифрландыру тиімділігі

Аңдатпа

Мақсаты: Елдегі ауыл шаруашылығы дамуының ағымдағы жағдайын талдау және цифрлық факторларды пайдалану деңгейін бағалау арқылы ауыл шаруашылығын цифрлендіру процестерінің оның тиімділігіне ықпал ету дәрежесін анықтау, оларды енгізу және дамытудың негізгі мәселелерін бағалау.

Әдісі: Мақалада экономикалық-статистикалық әдістер қолданылды, оның ішінде салыстыру тәсілдері, корреляциялық талдау мен логикалық-аналитикалық әдістер.

Қорытынды: Елдегі ауыл шаруашылық қызметінің негізгі көрсеткіштерінің даму деңгейіне, сондай-ақ, цифрлық факторларды пайдалану деңгейіне баға берілді. Корреляциялық талдау әдістерін қолдану негізінде алынған мәліметтер бойынша ауыл шаруашылық параметрлері және саланы цифрлендіру деңгейі арасындағы байланыс дәрежесі анықталып, регрессиялық модель құрастырылды, осы модель негізінде болашақ жылдың параметрлеріне болжамдық баға жасалынды. Берілген салада цифрлық технологияларды пайдаланудың нақты мысалдары мен негізгі мәселелері қарастырылды.

Тұжырымдама: Зерттеу көрсеткендей, елде қолданылатын цифрлық факторлар ауыл шаруашылық тиімділігін сипаттайтын көрсеткіштерге өте жағымды ықпал жасайды және оның әлеуеті өте жоғары екені анықталды, алайда, қазіргі уақытта біздің елімізде бұл ықпалдың деңгейі өте төмен, мардымсыз аз және бұл процесс жүйесіз сипатта өтетіндіктен, оның елдегі қолданылу географиясы фрагментарлы түрде болғаны анықталған.

Кілт сөздер: цифрлендіру, ауыл шаруашылығы, тиімділік, цифрлық технологиялар, корреляция, нақты егіншілік, цифрлық факторлар.

Д.О. Калдыбаева, Б.М. Баядилова, А.С. Койчубаев

Эффективность цифровизации экономики сельского хозяйства

Аннотация:

Цель: Анализ текущего состояния развития сельского хозяйства в стране и оценка уровня использования цифровых факторов позволили определить степень влияния процессов цифровизации сельского хозяйства на ее эффективность, оценены основные проблемы их внедрения и развития.

Методы: Использованы экономико-статистические методы, в частности, методы сравнения и корреляционного анализа, логико-аналитический.

Результаты: Дана оценка уровня развития основных показателей сельскохозяйственной деятельности страны, а также уровня использования цифровых факторов. По полученным данным на основе применения методов корреляционного анализа была определена степень связи между параметрами сельского хозяйства и уровнем цифровизации отрасли, составлена регрессионная модель с прогнозной оценкой параметров будущего года. Рассмотрены конкретные примеры использования цифровых технологий и основных проблем в данной сфере.

Выводы: Исследование показало, что применяемые в стране цифровые факторы очень положительно влияют на показатели эффективности сельского хозяйства и имеют высокий потенциал воздействия, но данное влияние в настоящий момент в нашей стране носит очень незначительный, малозаметный характер, и этот процесс не систематичен, фрагментарен по географии использования в нашей стране.

Ключевые слова: цифровизация, сельское хозяйство, эффективность, цифровые технологии, корреляция, точное земледелие, цифровые факторы.

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