IRSTI 06.71.07

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Digital Technologies and their Effects on and Usefulness to the Competitive Potential of the Agricultural Sector

Abstract: A digital economy is one of the key priorities of the modern world and is being used in all areas of society, including agriculture. Prospects for the development of agriculture can not be imagined without digital transformation. Digital economy in agriculture is aimed at satisfying the needs of the population in food, ensuring the growth of the agro-industrial complex, and especially the volume of export production, the growth of revenue from the use of resource potential, cost optimization and productivity increase.

The relevance of the study is the introduction of digital technologies in the field of agriculture, including drones, unmanned vehicles, automated robots. According to experts, the introduction of digital technologies will save 20-30% of the costs of agricultural enterprises. The main purpose of the article is to consider the issues of integrating digital technologies into agriculture.

Keywords: agriculture, competitiveness, digital technology, drones and equipment that does not have a driver.

DOI: https://doi.org/10.32523/2079-620X-2019-4-28-37

Purpose and objectives of the research. Taking into account the developmental strategies for agricultural sector in the economies of developed countries,increasing the profitability and productivity of the agro-industrial complex, attracting investments by means of digitalization, developing innovative digital technologies, and improving the efficiency and competitiveness of agricultural production.

Research methods. Comparison, systematization, classification and economic-mathematical modeling of economic and statistical indicators.

Discussions and results. The world has come to the era of digital globalization. Thanks to this, our country has started to use small, but fast, cheap and powerful smart devices in agriculture. Today, the most important services in the field of agriculture are easily performed. Digital technologies have accelerated spring fieldworkfor foreign artisans.

Technology development makes life easier and makes it more comfortable. Artificial Intelligence gradually takes its place in all areas and engineers are developing many new projects. Currently, the development of non-pilot cars is gaining popularity. The President of the Republic of Kazakhstan N. Nazarbayev N. Nazarbayev states that «unmanned machinery will remove the human factor and significantly reduce the cost of farming» [1].

According to experts, the introduction of digital technologies will save 20-30% of the costs of agricultural enterprises [2].

This technology has a lot to offer to farmers. First, it saves time. During spring fieldwork, it is clear that every minute of the year is expensive for entrepreneurs. Secondly, dispatchers, agronomists and mechanics will avoid making mistakes. Thirdly, this will help to address the shortage of agronomists, mechanics, economists and accountants in this sector in Kazakhstan.

Business managers can see the work done and done electronically. In the old system, the accountant would have to wait for the night shift to complete his accounting. Later, he would estimate how many hectares of land were planted. Now the situation is different. The results of all work will automatically come to the computer. You can do the job at night. Agronomists,

directors and economists can easily get acquainted with that information. They will be able to make future projections based on this data.It will be possible to track the tractors and their movements by installing appropriate technology. If necessary, the driver will also be given instructions. Technology makes it easier for economists and accountants to work. This is because it will allow them to know the amount of grain, and see what's going on in the wharf. At the same time, the accountants' jobs are made even easier, as they will need to calculate the sowing hectares only once. After all, the hectare figures will arrive on a daily basis. Even salaries of employees are calculated using this program. Thus, each employee will be paid a salary depending on the area of the field. This will make it much easier for economists to work. In addition, fuel burns, tractor shutdowns, and mechanized action will be easier to monitor. Unexpected shortages of fuel in some tractors will no longer be an issue, as workers will be able to monitor these via digital technologies. Now, managers of households can monitor every liter of diesel. It also predetermines how many hectares of fuel a tank will reach and how long it will be exhausted. Computers will run special dispatchers. They will watch out over all possible issues. The deficiencies will be known not only after work, but also when they are in progress. This allows you to quickly fix these bugs.

Digital technology has simplified the work of ordinary combine harvesters. Mechanisms have also been simplified. Because these specialists are only required to manage the equipment only in the direction the dispatcher has provided. And if he is misled, he will be informed immediately. There is an opportunity to correct the mistake right away. In general, thanks to such advantages, the speed of work has increased, and the quality of sowing has improved dramatically.

Thanks to the computers installed on the tractors, work has been made easier. This technology also shows any urgent problems. The amount of grain is being sowed is can also be monitored. The sequence in which the seeds are being planted can be observed. Working with such technology is not difficult.Working with vehicles without digital technology is a burden. It's up to the driver to look at it all. The condition of the tractor, fuel and fuel should also be monitored. Now the situation with modern technological equipment has improved.

With the help of digital technology, you can now monitor the state of sown areas. The chemical processing of crops and removing weeds can also be programmed into the technology and executed accordingly. With the help of these technologies, there is a great chance to reap an abundant harvest in autumn.

Foreign countries have long used digital technologies in agriculture. That is why they have a lot of experience in this business. Today, border specialists have made significant progress in eliminating errors, making quick decisions, and identifying the fertility of crops.

They use 3 main programs in agriculture. These allows work to develop in the direction of digital technology. The first of these projects is called exactfarming. With the help of this program, you can control labor in the fields. In the second program, observational equipment is installed on all units. The information provided by these mechanisms comes from the second Agrobank project. Thanks to this, specialists see the tractors' direction, speed and quality of work from a distance. The third program is called geosis. This innovationgreatly simplifies the work. Thanks to this technology, it is possible to see sprouting of arable land. Through it, it is possible to determine the rate of growth and the state of grain crops.

The development of non-pilot vehicles is carried out in three directions: consumer (private car, taxi, city road network); production (special equipment); military (military equipment of different purposes). The introduction of drones contributes to the development of the world economy [3].

Works on the production of non-pilot agricultural machinery, self-piloted airplanes, and unmanned tractors are carried out in the world. An unmanned tractor made by CNH Industrial (FIAT Group) in Italy is completely non-wired. Manufacturers are convinced of the future of this development because the self-piloted tractor works faster in any weather, with any trailer; it can

perform any operation [4].

The tractor is equipped with several radars and video cameras. Its operation is controlled by the on-board computer system and the remote operator.

Detailed information about sowing and crop cultivation is pre-loaded onto the control system. If obstacles are detected, the operator will be responsible for further maneuvering [5].

Driverless machines - there are such technologies in agriculture. The potential of these machinesis widely used in the development of ideas bytechnicians and ideas of production workers and implementation of technological operations in the production of agricultural products. In cattle breeding - robots for automated beef cattle, in plant breeding - working directly on field grounds, i.e. in planting and harvesting and for the transformation of products.

One of the promising directions of exact agriculture is unmanned aerial vehicles (drones). Drones are remotely controlled aircraft without a crew on board [6]. Drones have been used for commercial purposes since the early 1980s. In recent years, opportunities for practical use of drones have begun expanding [7, 8]. Unmanaged aircraft are used to track and control the animals in the field of animal husbandry, and they are used to track field crops, collect data and process chemicals for crops.

Given these factors, we will perform a correlation-regression analysis and calculate the impact ofdigital technologies on the competitiveness of Kazakhstan's agriculture.

The regression indices show a two-way correlation relation, the mean value of the change in the mean value of x χ and the value of χ in the X sign indicates X, and on the contrary, the change in the average value of the X sign shows xi. The change in the signals at this time indicates that the timeline will not be eliminated. Regression of this sequence is one-sided [9].

To achieve this we get the following indicators, which influence the penetration of digital technology into the agricultural sector:

- level of innovation activity of farms in introducing digital technologies;
- internal costs for R & D;
- Number of broadband internet subscribers per 100 people, unit;
- Number of employees performing R & D, human;
- the number of Internet users aged 16-74 per 100 people;
- number of organizations (enterprises) engaged in R & D;
- share of organizations using computers, percent;
- share of organizations using intranet;
- average wage of agricultural workers;
- the number of active universities in the introduction of the CT;
- IT import, mln. USD;
- Total costs for information and communication technologies.

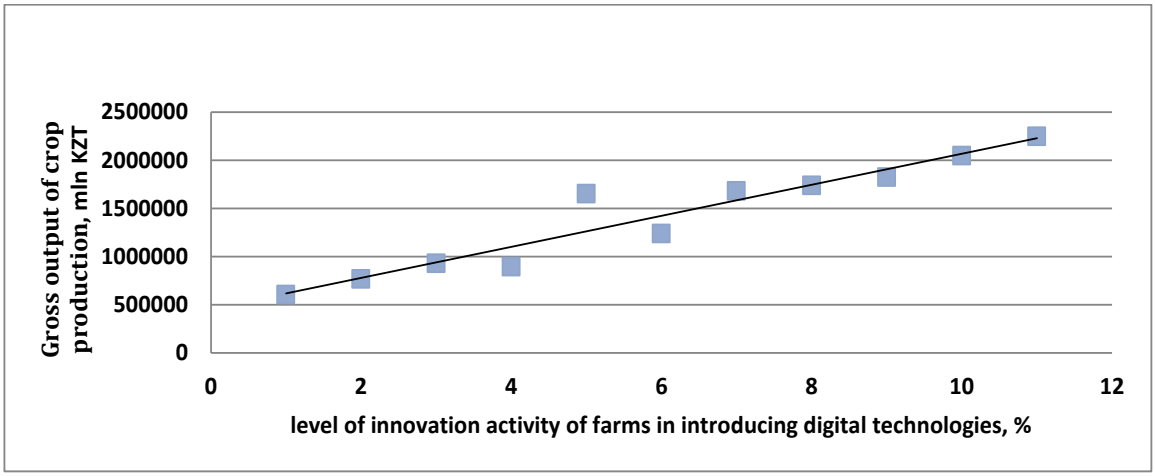
In the analysis, we first find that there is a link between the aggregate output of agricultural products and the quantitative technology indicators. We do this for correlation-regression analysis (Table 1).

Table 1

Indicators of innovation activity of farms on introduction of gross output of agricultural products and introduction of digital technologies

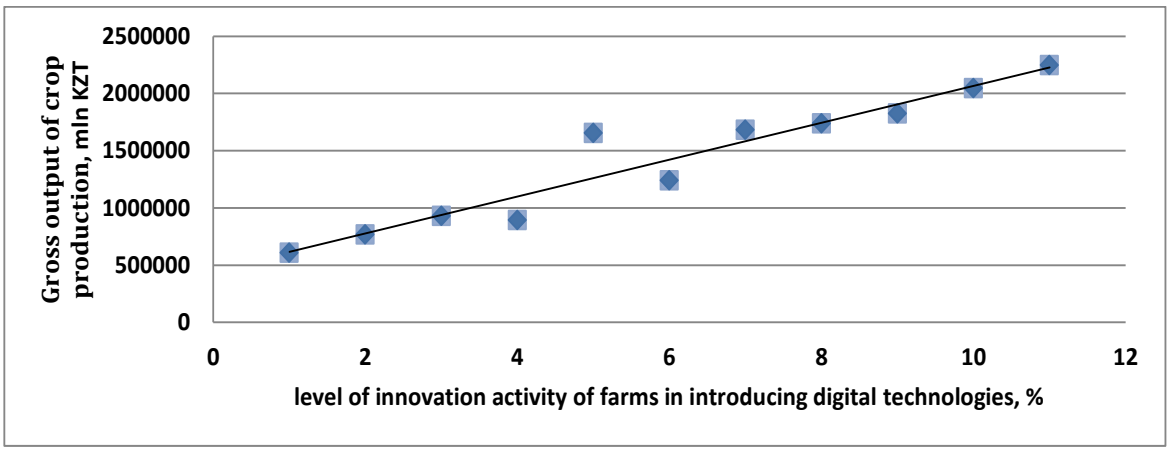
Year	Level of innovative activity of farms on introduction of digital technologies,percent	Gross output of agricultural products (services), mln. KZT		
		Crop production	Animal husbandry	Services in the industry
2008	4,0	770 239,6	628 601,0	5 652,0
2009	4,0	932 305,1	703 174,5	5 872,8
2010	4,3	895 425,2	920 777,3	5 871,7
2011	5,7	1 654 428,5	1 059 561,3	6 463,6
2012	5,7	1 241 517,0	1 145 437,3	6 664,7
2013	8,0	1 683 851,4	1 256 871,7	8 761,9
2014	8,1	1 739 436,4	1 393 762,0	10 479,7
2015	8,1	1 825 236,7	1 469 923,1	11 849,8
2016	9,3	2 047 580,8	1 621 541,4	15 271,1
2017	9,6	2 249 166,9	1 810 914,1	10 835,8

In the chart above, we have developed a schedule of dependencies on charts 1 and 2. As the graph shows, as the level of innovation activity of farms on the introduction of digital technologies increases every year, we see that the total output of crop production and cattle breeding grows accordingly.



Note: Created by the author

Diagram 1 - Thedependenceofthetotalvolumeofindustrialoutputon the introduction ofdigital technologies in 2007-2017



Note: Created by the author

Diagram 2 - The dependence of total output of animal hudbandry products on the introduction of digital technologies in 2007-2017

Indicators of activity level on introduction of gross output of agricultural products and introduction of digital technologies into farms between 2007 and 2017 show a steady dependence.

The following table identifies the regression and statistical dependence of the total output of plant and livestock products, the value of services provided in the agricultural sector and the introduction of digital technologies.

Table 2

Regressive statistical dependence of the level of aggregate output of agricultural products (services) and introduction of digital technologies

Indicators	Regressive statistical dependence of the level of aggregate output of agricultural products (services) and introduction of digital technologies		
	regressive statistical dependence coefficient for plant growing	coefficient of regressive statistical dependence on livestock	regressive statistical dependence coefficient for services in sectors
Multiple R	0,958301126	0,966228246	0,892735389
R-squared	0,918341047	0,933597024	0,796976475
Quantity R-squared	0,908133678	0,925296652	0,771598535
Standarderror	0,663401028	0,598229754	1,046037899
Control	10	10	10

The above table shows the interaction between plant breeding and gross output of livestock on the introduction of digital technologies into farms. It has a R factor ratio of 0.918 relative to plant husbandry, and the R-squared ratio of cattle breeding was 0.934. This means that the total output of crop production and cattle breeding is highly dependent on the introduction of digital technologies in the economy. Gross output of services in the agricultural sector indicates the average dependence on the introduction of digital technologies in the economy. According to this statistical dependence of the regression R squared is 0.797 coefficient.

To make this analysis clearer and more accurate we use multi-factor regression. For this purpose the dependent indicators that influence the increase of innovation activity of farms on introduction of digital technologies were chosen. These include: total output of agricultural products, investment in agriculture, internal expenditures for R & D, number of broadband Internet users per 100 people, number of R & D staff, number of 16-74 year olds per 100 people, Number of organizations (enterprises) involved in R & D, share of organizations using computers, share of organizations using intranets, average wage of employees in agriculture, active flour Imports of the University, the number of IT.

Using these indicators, we determine the effect of various factors on the introduction of digital technologies in the economy through regression.

Before beginning a regression analysis, it is necessary to establish a close relationship between the interdependent factors. We define it by the correlation coefficient. The correlation coefficient is the meter of the relationship between two random variables. If the correlation coefficient is close to +1 or -1, then the dependence is high. If the correlation coefficient is close to 0, then the connection between them is weak. The correlation analysis of indicators is shown in the table.

Conclusion. The correlation analysis of indicators indicated that not all indicators affect the level of innovative activity of the enterprises on introduction of digital technologies. The high bandwidth rated by the module is equal to or higher than the coefficient 0.85. In this regard, we deduct from the correlation analysis table of indicators the coefficients below the value of 0.85.

The correlation analysis of indicators shows that there are eight indicators that have a high impact on the innovative activity of enterprises in implementing digital technologies (Table 3). They are: X1 - total output of agricultural products, X2 - investment in agriculture, X3 - internal costs for R & D, number of broadband Internet users per X4 - 100, number of employees performing R & D, X6 - 100 the number of users aged 16-74 years per capita, X7 - the average salary of employees in the agricultural sector and the number of universities in the X8.

The general regression equation is calculated by the following formula: (1)

$$\boldsymbol{Y = b_0 + b_1 X_1 + b_2 X_2 \ldots + b_n X_n}$$,

here

Y - indicator of dependence (in our case, level of innovative activity of farms on introduction of digital technologies);

$X_1, X_2 \ldots, X_n$ – Factors;

$b_0, b_1, b_2 \ldots, b_n$ – coefficients.

Table 3

Multidimensional regression

Year	Y (Innovative activity level of enterprises on introduction of digital technologies)	X1	X2	X3	X4	X5	X6	X7	X8
2008	4	1404 492,60	63 996 726	63 996 726	20246,6 4	16 304	15	36938	143

2009	4	1 641 352,40	74 001 924	22866,5	5	15 793	18	37307	148
2010	4,3	1 822 074,10	92 369 685	19457,5	6	17 021	32	40214	149
2011	5,7	2 720 453,40	98 628 464	21814,2	8	18 003	50	44986,1	146
2012	5,7	2 393 619,00	128 214 976	27089	10	20 404	68	51044,9	139
2013	8	2 949 485,00	142149262	29566	12	23 712	68	58304,2	128
2014	8,1	3 143 678,10	166397092	34196	12,2	25 793	68	66483,4	126
2015	8,1	3 307 009,60	167078229	37220,7	13	24 735	77	72507	127
2016	9,3	3 684 393,20	252929385	37078	13	22 985	80	81572	125
2017	9,6	4 070 916,80	352508272	37987,4	15	22 081	83	90757	122

Table 4

Regression statistics (Conclusion)

Multiple R	0,980742
R-squared	0,961856
Quantity R-squared	0,950958
Standard error	0,478848
Control	10

We implemented the results of the regression analysis using Excel (table 4). The regression statistics show that the correlation coefficient is equal to 0.980 (Multitude R). It shows a close link between factors. Determination coefficient R-squared equals 0.950. This model is interpreted as positive.

If we calculate the regression equation in the formula above, it will be as follows.

Y = 17,26357+(1,6E-06*1 404 492,6)+(-2E-09*63 996 726)+(-4,5E-05*20246,6)+(-0,02088*4)+(1,49E-05*16 304)+(-0,00169*15)+(1,39E-05*36938)+(-0,10456*143)

Here,

Y - level of innovative activity of farms on introduction of ST,%;

X1 - Gross output of agricultural products, mln.

X2 - Investment in agriculture, thousand tenge;

X3 - internal costs for R & D;

X4 - Number of Broadband Internet subscribers per 100 people, units;

X5 - the number of R & D personnel executed;

X6 - the number of Internet users aged 16-74 per 100 people;

X7 - average wage of employees in agriculture, KZT;

X8 - The number of universities.

As a result of calculating the regression equation in the above formula, the influence of these factors (X1-X8) shows the growth of innovative activity of farms on introduction of digital technologies.

Finally, the new technologies are profitable for peasants. By using digital technologies, domestic farmers are less expedient and more profitable. But the introduction of these new

technologies into the farms creates some difficulties. It is desirable that there are more educated and qualified specialists in the country to implement it 100%.

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Сандық технологиялардың ауыл шаруашылығының бәсекелік қабілеттілігіне тигізетін әсері және тиімділігі

Аңдатпа. Цифрлық экономика қазіргі әлемдегі басты басымдықтардың біріне айналуда және қоғамның барлық салаларында, соның ішінде ауыл шаруашылығында қолданыла бастады. Ауыл шаруашылығының даму перспективаларын сандық түрлендірусіз елестету мүмкін емес. Ауыл шаруашылығындағы цифрлық экономика халықтың азық-түлікке деген қажеттілігін қанағаттандыруға бағытталған, агроөнеркәсіптік кешеннің, әсіресе экспорттық өндірістің өндіріс көлемінің, ресурстық әлеуетті пайдаланудан түскен табыстың өсуін, шығындарды оңтайландыруды және өнімділікті арттыруды қамтамасыз етеді.

Зерттеудің өзектілігі ауыл шаруашылығында сандық технологияларды дамытудан, соның ішінде дрондар, жүрізушісі жоқ техникалар, автоматтандырылған роботтрадың жұмысын жасақтаудан көрінеді.

Мамандардың пікірінше, цифрлық технологияларды енгізу ауыл шаруашылығы кәсіпорындарының шығындарының 20-30%-ын үнемдеуге мүмкіндік береді. Мақаланың басты мақсаты - ауыл шаруашылығына сандық технологияларды толықтай енгізу мәселелерін қарастыру.

Түйін сөздер: ауыл шаруашылығы, бәсекеге қабілеттілік, сандық технологиялар, дрондар, жүргізушісі жоқ техникалар.

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Влияние и эффективность цифровых технологий на конкурентоспособность сельского хозяйства

Аннотация. Цифровая экономика является одним из ключевых приоритетов современного мира и используется во всех сферах жизни общества, включая сельское хозяйство. Перспективы развития сельского хозяйства невозможно представить без цифровой трансформации. Цифровая экономика в сельском хозяйстве направлена на удовлетворение потребностей населения в продуктах питания, обеспечение роста агропромышленного комплекса, особенно объема экспортной продукции, рост доходов от использования ресурсного потенциала, оптимизацию затрат и повышение производительности. Актуальность исследования связана с внедрением цифровых технологий в области сельского хозяйства, в том числе дронов, безпилотных машин, автоматизированных роботов. По мнению экспертов, внедрение цифровых технологий позволит сэкономить 20-30 % затрат сельскохозяйственных предприятий. Основная цель статьи - рассмотреть вопросы интеграции цифровых технологий в сельское хозяйство.

Ключевые слова: сельское хозяйство, конкурентоспособность, цифровые технологии, дроны, беспилотные техники.

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