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THE ROLE OF DIGITAL TECHNOLOGIES FOR MANAGEMENT DECISIONS MAKING IN AGRICULTURE

This article discusses the effectiveness, necessity and prospects of the introduction of resource-saving technologies in agriculture in the modern economic conditions of the Republic of Kazakhstan. The topic of the article reveals the relevance of the use of modern digital technologies for the cultivation of grain crops. The need to abandon the classical technology, which entails a loss of yield of up to 15%, and also negatively affects the soil cover of the earth, that is, provokes soil erosion, is justified. And also analyzed the condition of the technical park, the wear of which is more than 50%, which also negatively affects the economic condition of agro-industrial complexes.

Reasonable use of resource-saving technologies helps to reduce fuel costs, significantly reduces the need for tillage before sowing, thereby saving money, and also increases the yield of cultivated crops and, accordingly, the level of profitability. According to the results of the study, appropriate conclusions are drawn.

Keywords: *precision technology, digitalization, management solutions, efficiency, crop productivity, new technologies, acreage, yield per unit, modern technologies, accounting.*

Кілт сөздер: *нақты технологиялар, цифрландыру, басқару шешімдері, тиімділік, ауыл шаруашылығы дақылдарының өнімділігі, жаңа технологиялар, егіс алқаптары, өнімділік.*

Ключевые слова: *точные технологии, цифровизация, управленческие решения, эффективность, урожайность сельскохозяйственных культур, новые технологии, посевные площади, урожайность на единицу продукции, современные технологии, бухгалтерский учет.*

Introduction. The relevance of the topic is the need to use modern digital technologies, which are becoming a key condition for the development of competitive agricultural production in the face of global challenges and threats. Due to the current state of scientific and technological progress, farmers can not only use digital technologies in production, but also make agriculture manageable and predictable as a whole. The efficiency of agriculture in developed countries is many times higher than in the CIS countries, including Kazakhstan, largely due to digitalization. The close attention has been recently paid to the development of digital agriculture from the state, due to the need to provide this industry with modern technologies, although there is no hurry on the part of farmers to switch to digital technologies, and that is understandable since many problematic issues have not yet been considered and resolved in legislative documents.

The purpose of this article is to determine the effectiveness of introducing digital technologies and identify problems in agriculture in Kazakhstan. The article justifies the need to switch to digital technologies in agriculture in combination with the solution of the following issues on technical maintenance, internal skills and variety renewal, which should not be considered in isolation. It also considers topical issues on the problems of introducing digital technologies for agricultural producers as one of the effective tools for making management decisions.

Literature review. According to the observations of the Ministry of Agriculture of the Republic of Kazakhstan, 'precision farming with the use of new technologies and equipment made it possible to get 2.5 times more yield at pilot sites. At the same time, farmers ' expenses were reduced by more than 20% [1].

According to research by the Food and Agriculture Organization FAO (UN) [2], the annual grain losses account for up to 30% of the total production. On average, this figure amounts to 10% worldwide, and in the CIS countries (including Kazakhstan) – up to 25%. 'Application of modern technologies in agriculture'

and others on the ELIBRARY.RU portal, the works of the following authors can be found: Alenina K.A., Gribanov Yu.I. [3], Vartanov M.L., Drobot E.V. [4]; Kuladzhi, Babkin, Sokolova, Murtazaev [5], Makarov I.N. [6], Ryzhenko A.A. [7], Ushachev I.G., Maslova V.V., Chekalin V.S. [8], Chupakhina A.V., Chechin A.I., Konoplin A.N. [9] and other authors. In the scopus database, the works of Tokenova S, Kulekeshova A. [10] are devoted to studying in this area .

The key role in the agro-industrial complex is given to agriculture. The diverse climatic conditions of the Republic of Kazakhstan allow growing almost all crops of the temperate zone [11].

Increasing the efficiency of agricultural enterprise management through digitalization technologies contributes to maintaining competitiveness in the market. To work without digitalization means to lose in the global competition [12]. To make the right management decisions, you need information, data that allows collecting such technologies as satellite images, high-tech sensors, GPS systems, etc. The digitalization of agricultural production in the Republic of Kazakhstan should provide an increase in crop production for the next 3-7 years.

The main part. The theory and methodology of this article are based on the problems of implementing digital technology for grain cultivation. The calculation methods and procedures were based on official statistics on the availability of major types of agricultural machinery for the period from 2012 to 2019, and also on the data on productivity and costs in the farms of the test site [13]. Table 1 provides the information on yield.

Table 1

Average indicators of wheat yield before the introduction of precision technology*

Farming enterprises	LLP «Naidarovskoye»	LLP «Dikhan Plus»	LLP «Shakhterskoye»	LLP «Troyana»	LLP «Shagala Agro»
Yield, c/ha	11,6	12,1	12,3	13,7	16,9

** Compiled by the author on the basis of farm data*

As it can be seen from the average statistical data, the yield varies within 11-17 centners per hectare, while in Russia this figure exceeds 1.5-2 times, which is due to the introduction of precision technology. Therefore, the introduction of information technology should solve the problem of optimizing operating costs and increasing yields.

Results. However, in terms of Internet connectivity in the fields and the use of IT solutions, Kazakhstan is actually not far behind the advanced agricultural countries. However, the credit entirely goes to progressive agricultural holdings, which are actively implementing all sorts of new solutions in their fields. In 2018, as part of digitalization on the basis of the A. I. Barayev Research and Production Centre for Grain Farming, a pilot project for the introduction of 'precision farming' has been launched. Using the example of spring wheat production, the efficiency of using resource-saving technologies with elements of precision farming was considered, table 2.

Table 2

The planned expenses for the introduction of precision farming technology, tenge*

Name	Unit of measure	Price per unit	Quantity	Price	Subsidies	Load per 1 ha
1	2	3	4	5	6	7
Agrochemical analysis (determination of easily hydrolyzed nitrogen and labile phosphorus), 5 ha grid	sample	2284.0	400.0	913600.0	-	456.8
Purchase of mineral fertilizers (fallow fields 150 kg in gross weight./ha)	tons	125000.0	300	37500000.0	18750000.0	4687.50
Installation of the system of discriminatory application of fertilizer and parallel driving of 'Agronavigator'*	package	1600000.0	1	1600000.0	-	32.0

1	2	3	4	5	6	7
Chisel – fertilizer distributor for applying the main dose of fertilizer**	pc	5000000.0	1	5000000.0	1250000.0	100.0
Expenses for security equipment**	ha	8450	2000	16900000.0	2957500.0	6971.25
Consultative support services	service	3740438.41	1	3740438.41		1870.22
Total expenses				65654038.41		
Cost per 1 ha						14 117,77

** Compiled by the author based on the project layout*

Consultative support services include payment for experts in the development of electronic soil cartograms, the interpretation of digital data and agrochemical cartograms in relation to the calculation of fertilizer doses and their application, Earth's remote sensing, imaging, weeds and diseases, and economics

Let us consider the effect of the introduction of precision farming technology on the example of farms, table 3.

Table 3

Impact from the introduction of precision farming in the pilot project*

Farms	Area, ha	Crop (breed)	Average yield c/ha	Yield on the pilot field, c/ha	Growth c/ha
'Dikhan Plus' LLP	145	durum wheat (pearl of Siberia)	12.1	26.0	+13.9
'Naydarovskoe' LLP	250	durum wheat (Durum)	11.6	50.2	+38.6
'Shachterskoye' LLP	160	spring wheat (Shortandy 2012)	12.3	28.2	+15.9
'Troyana' LLP	400	Wheat (Lubava 5)	13.7	22.0	+8.3
'Shagala Agro' LLP	153	Spring wheat (Astana 2)	16.9	44.0	+27.1

** Compiled by the author on the basis of farm data*

The table data for some of the farms of the pilot project showed the following results: the largest increase in yield was received by the farms 'Naydarovskoe' 50.2 c/ha and 'Shagala Agro' 44 c/ha for 'Durum' and 'Astana 2' wheat varieties, other farms received a yield increase in the range of 8.3-15.9 c/ha (crop loss due to weather conditions and less stable wheat varieties, and other factors). Consider the cost of fuel for the cultivation of grain, table 4.

Table 4

Average fuel consumption per 1 ha of grain crops

Indicator	Type of technology		
	traditional	minimum	zero
Fuel consumption, kg / ha	18.6	12.4	6.2

As can be seen, the introduction of new technologies helps to reduce fuel consumption costs.

According to the minimum and zero technology, water availability is close to 39.8-47.2 mm before sowing, 25.1-44.8 mm before harvesting. The lowest water availability by traditional technology before sowing is 19.8 mm and before harvesting - 17.9 mm, see table 5.

Table 5

Reserves of productive moisture in steam and grain fields depending on the system of tillage

Soiltechnology	On average by crop rotation	Productive moisture, mm	
Traditional		19.8	17.9
Minimum		39.8	25.1
Zero		47.2	44.8

The expenses and revenues directly depend on the yield, market situation and sales processes, as well as other factors. The risk factors are anything that can negatively affect earnings. There are a lot of risks: what will the weather be like; will there be an invasion of locusts; what diseases can be dangerous for animals in the coming season; are the workers qualified enough; is everything in order with the equipment? Before taking a particular step, you need to be absolutely clear about the risks it involves and what is the price of each such risk [9].

It should be noted that agriculture faces the problem of the lack of qualified personnel for the agro-industrial complex, table 6.

Table 6

Availability of mechanized personnel, number of people*

Regions	Mechanizers			Including				
	required	available	lacked	truck drivers	combine drivers	drivers	mechanized current operators	mechanical trades
Kazakhstan								
Western region	9638	9125	513	271	83	119	2	38
Northern region	56552	55671	881	450	285	102	36	8
Central region	1964	1814	150	94	28	18	4	6
Southern region	48344	47266	1078	581	239	151	16	91
Eastern region	4617	4026	591	132	328	40	7	84
in the Republic	121,115	117,902	3 213	1528	963	430	65	227

** Compiled by the author on the basis of statistical data, Source: stat.gov.kz [12]*

The next problem is that the existing vehicles and drilling equipment are characterized by wear and tear of more than 80 %, and computer and office equipment, as well as special field and laboratory equipment, are in the same condition (figure 1).

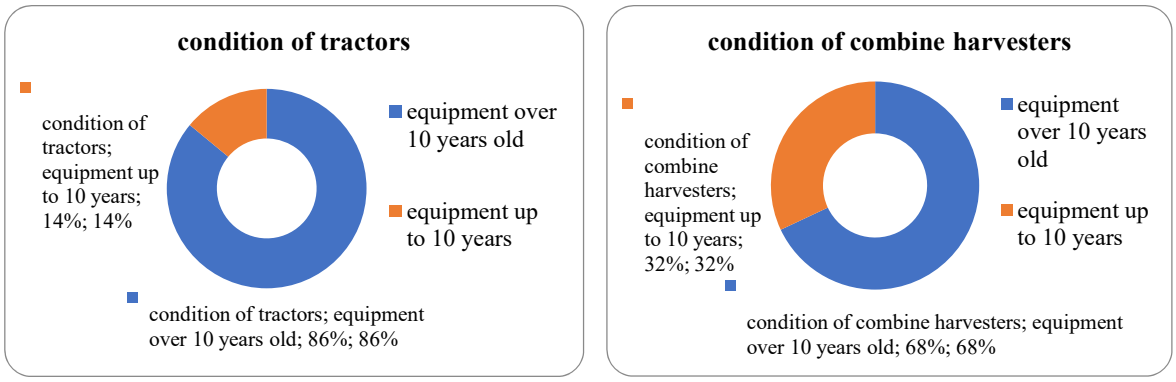

Figure 1. **Availability of basic agricultural machinery in Kazakhstan, units***

** Compiled by the author on the basis of statistical data, Source: web-site: MOA[12]*

The wear and tear of agricultural machinery in Kazakhstan is about 80%. According to the Ministry of Agriculture of the Republic of Kazakhstan, the average age of more than 70% of grain combine harvesters and trucks is 13-18 years with a standard service life of 8-10 years. In addition, more than 70% of grain combine harvesters, about 80% of trucks, 75% of reaping machines, and 80% of seeding machines are subject to write-off , table 7.

Table 7

Technical condition of agricultural machinery in Kazakhstan on average over the last 10 years), %*

Types of equipment	The wear indicator is older than 10 years,%	Indicator of wear and tear,%
Tractors	70	30
Combine harvesters	80	20
Forage harvesting equipment	85	15
Tillage equipment	80	20

** Compiled by the author on the basis of statistical data, Source: stat.gov.kz [12]*

Taking into account that the average service life of agricultural machinery is 10 – 12 years, it can be concluded that the actual service life of equipment exceeds the statutory service life by 3 – 10 years [10]. The outdated equipment leads to delays in sowing and harvesting, excessive fuel and spare parts costs, crop losses, and other negative consequences for farmers in general. Therefore it is necessary to increase the subsidies for agricultural machinery.

According to the pilot project, it can be seen that the use of precision technology also has an impact on less resistant wheat varieties. 'The staff of agricultural science in the region is of great concern. Currently, there are only 4 grain breeders with a scientific degree in the scientific institutions of Akmola, Karaganda and North Kazakhstan regions. Moreover, two of them are over 70 years old!' [14]. At the present stage, there is no production of seeds of new varieties in Kazakhstan, but on the contrary, they produce seeds of the same variety, whereas, in such countries as Russia and Canada, the variety renewal is carried out every 5-7 years, which has a beneficial effect on the yield of grain.

The motivation of farmers for high technologies, one of which is the precision technology, is mainly connected with the ability to reduce costs.

The advantage of implementing such solutions is the ability to save on almost everything. The automation of stationary farms contributes, first of all, to solving problems of energy saving [15]. In this connection, another problem is control of costs, which facilitated the managerial decision-making. That is, almost all agricultural enterprises lack an accounting and analytical management accounting system (there is a large inaccuracy in data collection and, as a consequence, inaccuracy of management documentation). Thus, questionable data of land leads to the fact that an accountant, financial expert, agronomist and the head of enterprise may have different data on the area of the same field; there is an insufficient account of both the crop seeds and the yield. Therefore, the solution to this problem can be found in using the 'AgroStream' program, as one of the most important areas of digital transformation is the establishment of automatic data exchange between the machine and office systems. In this segment, John Deere, in partnership with the Russian company CPS, released the AGDI (Ag Data Integrator) solution, which automatically exchanges data between John Deere equipment and a 1C-based office system in a two-way format. The system allows to not only monitor the technical characteristics of the machine but also performs the functions of an agricultural operator with the implemented work functionality according to instructions. Despite the fact that this solution was developed as part of the John Deere digital ecosystem, it allows integrating equipment from different manufacturers in one system, and also allows using different map data [13].

Besides, the AgroStream information system, a domestic product known not only in Kazakhstan, but also abroad, has been developed for making management decisions. It is AgroStream that effectively collects and analyzes data, providing it in a form that is convenient for users who make management decisions, that is, the role of management accounting, and analytical system increases. Of course, in recent years, the information of the accounting and analytical system is aimed at making rational and effective strategic and tactical decisions.

IS 'Agrostream' (AgroStream) is a comprehensive information system that allows to plan, model, analyze and define the company's management system in terms of improving efficiency [10]. The service covers all areas of agribusiness activity: from planning and control to product cost analysis, plan-fact analysis, field history storage, and flow process chart for each field and crop.

Conclusion. In conclusion, it can be stated that the effectiveness of implementing digital technologies in agriculture largely depends on the following aspects:

1) first of all, to update the technical park, which is physically outdated by more than 80%, with brands of machinery equipped with information sensors;

2) The variety renewal also has an effect on the yield, the solution of which is breeding varieties of cereals, legumes, oilseeds, annual and perennial grasses adapted to the changing climate in the steppe regions of Kazakhstan.

3) The improvement of the precision farming system based on the demonstration of an accounting site. The cooperation with the leading scientific institutions and the transfer of advanced technologies in crop cultivation.

4) The development of human resources, training of farmers, as there is a shortage of personnel who could cope with the objectives.

5) The development of an accounting and analytical system based on the 'Agrostream' program for making management decisions. Therefore, while making the transition to digitalization, it is necessary to develop a unified concept of digital transformation, which would take into account the approach of an

integrated principle: the development of innovation in variety renewal, technical equipment, labor resources, climatic conditions. The level of the digital economy development in agriculture is closely related to the degree of information technologies implementation, since the introduction of digital tools increases the production efficiency, contributes to effective control and management decisions.

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АУЫЛ ШАРУАШЫЛЫҒЫНДА БАСҚАРУШЫЛЫҚ ШЕШІМДЕР ҚАБЫЛДАУДАҒЫ ЦИФРЛЫҚ ТЕХНОЛОГИЯЛАРДЫҢ РӨЛІ

Аңдатпа

Бұл мақалада Қазақстан Республикасының қазіргі экономикалық жағдайында ауыл шаруашылығына ресурс үнемдейтін технологияларды енгізудің тиімділігі, қажеттілігі және болашағы қарастырылған.

Мақаланың тақырыбы дәнді дақылдарды өсіруде заманауи цифрлық технологияларды қолданудың өзектілігін ашады. Классикалық технологиядан бас тарту қажеттілігі дәлелденді, бұл өнімділіктің 15% -ға дейін жоғалуына әкеледі, сонымен қатар топырақ пен топырақ құнарлылығына теріс әсер етеді, яғни топырақ эрозиясын тудырады. Сондай-ақ агроөнеркәсіптік кешендердің экономикалық жағдайына кері әсерін тигізетін тозуы 50%-дан астам техникалық парктің жай-күйіне талдау жасалды.

Ресурс үнемдейтін технологияларды ұтымды пайдалану отын шығынын азайтуға көмектеседі, жабдықтың тозуын азайтады, егіс алдында топырақ өңдеу қажеттілігін айтарлықтай азайтады, осылайша қаражатты үнемдейді, сонымен қатар мәдени дақылдардың өнімділігін арттырады және табыстылық деңгейі. Зерттеу нәтижелері бойынша тиісті қорытындылар жасалады.

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РОЛЬ ЦИФРОВЫХ ТЕХНОЛОГИЙ ДЛЯ ПРИНЯТИЯ УПРАВЛЕНЧЕСКИХ РЕШЕНИЙ В СЕЛЬСКОМ ХОЗЯЙСТВЕ

Аннотация

В данной статье рассматривается эффективность, необходимость и перспективы внедрения в сельское хозяйство ресурсосберегающих технологии, в сложившихся экономических условиях Республики Казахстан.

Тема статьи раскрывает актуальность применения современных цифровых технологий для возделывания зерновых культур. Обосновывается необходимость отказа от классической технологии, которая влечет за собой потерю урожайности до 15%, а также воздействует негативно на почву и плодородие земли, то есть провоцирует эрозию почвы. А также проанализировано состояние технического парка, износ которого составляет более 50%, что также негативно отражается на экономическом состоянии агропромышленных комплексов.

Обоснованное применение ресурсосберегающих технологий способствует снижению затрат на топливо, позволяет значительно снизить потребность в обработке почвы перед посевом, тем самым экономя средства, а также повышает урожайность возделываемых культур и уровень рентабельности. Сделаны соответствующие выводы по результатам исследования.