

Digitization of the agro-industrial complex – a power tool of development

Aida Dukeyeva

Department of Standardization and food technologies

Kostanay Engineering and Economics University named after M. Dulatov

Kostanay, Kazakhstan

dukeev-ka@mail.ru

Dinara Zhamalova

Department of Standardization and food technologies

Kostanay Engineering and Economics University named after M. Dulatov

Kostanay, Kazakhstan

tashdinara@mail.ru

Aigerim Yesmurzina

Department of Standardization and food technologies

Kostanay Engineering and Economics University named after M. Dulatov

Kostanay, Kazakhstan

aigerim.apple2016@bk.ru

Gainiya Yesseyeva

Department of Standardization and food technologies

Kostanay Engineering and Economics University named after M. Dulatov

Kostanay, Kazakhstan

gainia@mail.ru

Abstract—This article discusses the issue of digitalization of the agro-industrial complex, using the example of two locations of the same size, soil cover, predecessors, put up two sowing units “John Deere 1820”, a navigation system was installed in one of the units. According to the results of the sowing works, we see a positive moment from the agronomical point of view in the reduction of the terms of work. The introduction of digitalization on the example of a farm provides an opportunity to clearly monitor the positive dynamics, both from an economic point of view and a positive im-pact from an agronomic point of view, that is, yield increase, soil improvement using the law of return of substances to the soil, in a word level of farming. The value of this article lies in the timely detection of the initial stage of development of plant diseases in order to take preventive measures to localize and eliminate them. Here, the timeliness factor will help prevent up to 40% of the potential yield loss from diseases and prevent a decrease in the quality of grain. If we re-count it for the whole sown area of the republic, the benefit will be enormous.

Keywords—*digitalization, precision farming, navigation system, organic farming, yield.*

I. INTRODUCTION

Today, Kazakhstan is turning from a traditional industry into a highly technological one, although it is in a zone of risky farming.

In the Message of the President of the Republic of Kazakhstan N. Nazarbayev to the people of Kazakhstan dated January 10, 2018, it was said that the agrarian policy should be aimed at a radical increase in labor productivity and growth in exports of processed agricultural products. The development of agrarian science requires priority attention [1].

In 2018, it is necessary to begin the development of the third five-year plan of industrialization, dedicated to the emergence of the “digital age” industry. The state, together with the business, must find strategic niches in international markets and promote domestic products.

Intensification of agriculture should occur with preservation of the quality and environmental friendliness of products. This will allow creating and promoting the “Made in Kazakhstan” organic food brand, which should become recognizable in the world [2,3].

II. LITERATURE REVIEW

Digital technologies offer Kazakhstan farmers equal opportunities with overseas right now. For example, the possibility of so-called precision farming attracts great interest.

With the help of geological positioning systems, satellite images and maps of agrochemical survey of fields, farmers are able to accurately and faultlessly approach the application of fertilizers, the processing of fields, the definition of seeding rates of crops and the structure of crop rotation. As a result, costs are reduced, and the return of arable land is growing significantly [4].

The purpose of the digitalization of the AIC is to increase productivity and efficiency through the introduction of digital technologies. The digitalization process creates electronic field maps. To date, 24 million hectares of arable land has been digitized, almost 100% of the total sown area. Also, work began on the digitization of pastures. Farm productivity is enhanced by technologies such as:

- forecasting the optimal time for harvesting;
- smart irrigation»;
- intellectual fertilizer application system;
- pest and weed control system;
- systematic crop rotation system

Such a concept as “precision farming” is based on a deep and thorough analysis of the composition of the soil. On traditional farms, one analysis per 75 ha is carried out. On smart farms, the soil for analysis is taken from each hectare [5, 6].

This method helps to more accurately determine the volume and composition of fertilizers, and also determines the most appropriate methods of cultivation. A lot of work accomplishes artificial intelligence in the form of computer programs, manual labor is minimal. Computer systems can simultaneously process large amounts of data and constantly adapt conditions for favorable growth of agricultural production.

As part of a pilot project for the implementation of precision farming, 9 Kazakh farms are already using new

technologies and are showing excellent results. The best of the best in the digitalization of the agro-industrial complex are leading Akmola, Kostanay and Karaganda regions.

Kostanay region produces 22% of the total volume of grain in the country and 27% of the total volume of food falls to Kostanay region. In the region, 20 agricultural enterprises with good production indicators and effective growth and development were selected for the introduction of digitalization [7].

III. RESEARCH METHODOLOGY

Kostanay region is located in the north-west of the Republic of Kazakhstan, its area is 19.6 million hectares.

The vast territory of the region and the large extent of the territory, both from north to south (more than 800 km.) and from west to east (about 400 km.), caused a wide variety of natural conditions.

Changes in bioclimatic factors in the meridional direction influenced the allocation of three soil zones in the region: a) black earth soil zone; b) the zone of chestnut soils; c) the zone of brown soils of the northern desert [8].

Their presence is associated with an increase in aridity of climate from north to south. At the same time, the hydrothermal index (HI) varies from north to south from 0.9 to 0.3, the annual precipitation varies from 360 to 175 mm, and less, the moisture ratio varies from 0.37 to 0.09. The climate is extremely continental: hot and dry summers give way to cold snowless winter.

In July, the temperature rises to + 40, and in winter it drops to -40. Rainfall during the year falls a little and extremely uneven, from 300-350mm in the north, up to 175mm in the south of the region, with 70-80% of their annual amount falling on a warm period. There is a statistically significant probability of drought.

In order to get a more detailed picture, using the example of two locations of the same size, soil cover, predecessors, we set up two sowing units "John Deere 1820", and a navigation system was installed in one of the units. According to the results of the sowing, the following parameters were identified (Tables 1, 2, 3).

TABLE I. LOCATION NO. 47, AREA OF 530 HECTARES 20.05.2018

Full name	Tractor Type	Tractor number	Expenditures	Type of work	completed work				fuel and lubricant materials				Per 1 relative hectare
					days	hours	hectares	shift rate	residue at the beginning	Gassed up	spent	residue at the end	
Assaula O, Ryabov	JD 1820	81	wheat	wheat sowing	0,5	5	57	0,7			416		7,30
Assaula O, Ryabov	JD 1820	81	wheat	wheat sowing	0,5	5	93	1,2			679		7,30
Assaula O, Ryabov	JD 1820	81	wheat	wheat sowing	1	10	104	1,3			779		7,49
Assaula O, Ryabov	JD 1820	81	wheat	wheat sowing	1	10	94	1,2			686		7,30
Assaula O, Ryabov	JD 1820	81	wheat	wheat sowing	0,5	5	75	0,9			548		7,31
Assaula O, Ryabov	JD 1820	81	wheat	wheat sowing	0,5	5	42	0,5			307		7,31
Assaula O, Ryabov	JD 1820	81	wheat	wheat sowing	1	10	65	0,8			475		7,31
					5	50	530	6,6	889	3620	3890	619	7,34

TABLE II. LOCATION NO. 45, AREA OF 530 HECTARES 20.05.2018

Full name	Tractor Type	Tractor number	Expenditures	Type of work	completed work				fuel and lubricant materials				Per 1 relative hectare
					days	hours	hectares	shift rate	residue at the beginning	Gassed up	spent	residue at the end	
Strelkov, Rybin	John Deere 1820	82	wheat	wheat sowing	1	10	110	0,7			416		3,78
Strelkov, Rybin	John Deere 1820	82	wheat	wheat sowing	1	10	165	1,3			779		4,72
Strelkov, Rybin	John Deere 1820	82	wheat	wheat sowing	1	10	145	1,2			686		4,73
Strelkov, Rybin	John Deere 1820	82	wheat	wheat sowing	0,5	5	110	0,9			548		4,98
					3,5	35	530	4,1	621	3620	2429	1812	4,58

TABLE III. SUMMARY OF SURVEY RESULTS

	location number	seeding rate, t / ha	seed need, t	actually spent seeds, t	overrun, t	yield in hundredweight / ha	gross yield, t	number of plants, m ²
without navigator	47	0,156	82,68	87,64	4,96	10,4	551,2	435
with navigator	45	0,156	82,68	81,52	-1,16	12,3	651,9	396

From Tables 1 and 2 it can be seen that for carrying out the sowing work on a location of 530 hectares, the aggregate with the navigation system was spent in 3.5 days, and the sowing work on the aggregate without navigation lasted 5 days.

A positive moment from the agronomical point of view, we observe in the reduction of the terms of work. The zone of risky farming does not allow to stretch the sowing activities due to numerous factors, one of which is the deficit of moisture and the maximum in July.

- Fuels and lubricants are much more expended by the aggregate without a navigation system and the consumption per 1 conventional hectare was 7.34 l; unit with navigation system spent for 1 conditional hectare 4.58 l.

- output per shift is evident on the unit with the navigation system, where the average for 3.5 days was 151 hectares; on the unit without navigation, the average production for 5 days was 106 hectares.

Table 3 shows that the inoculum costs in Location No. 47 exceed the planned costs by 6%; in Location No. 45, the planned expenditure of seed material was reduced by 1.4%.

The relationship is obvious because the unit with the navigation system sows a full location without transfers and passes with the exact direction of movement, the parameters of which were previously stuffed into the navigation system. The unit without a navigation system is controlled by man and reseeding are not excluded.

As a result of reseeded, we observe in Location No. 47 the average number of plants in m² - 435 pcs / m², such a dense arrangement of plants causes competition for moisture and nutrients, as a result of which plants are weak, and growth and development are difficult. In Location No. 45, the average number of plants was 396 pcs / m², we see stronger and more well-formed stems, with timely development in phases.

IV. CONCLUSION

The control of the equipment supplied with navigation systems gives great advantages. Field parameters are set, which allows to avoid re-seeding and under-seeding. Owing to all this, we obtain uniform and amicable shoots. Due to selected soil samples and due to intelligent fertilizer application, digitized fields and electronic maps of agricultural land make it possible to get a 20% yield increase. Harvesting equipment is equipped with an online system for monitoring yield, humidity and grain unloading, ensures the safety of grain and full delivery from the field to the farm. The economic effect is the reduction of production

costs for fuel and lubricants, mineral fertilizers and plant protection products from 15 to 20%.

V. THE DISCUSSION OF THE RESULTS

As part of the Message to the people of Kazakhstan, the Strategy "Kazakhstan - 2050", "New Political Course" and "The Third Modernization of Kazakhstan: Global Competitiveness". The head of state noted that large-scale modernization of agriculture is necessary, especially in the context of growing global demand for agricultural products and the agro-industrial complex of Kazakhstan. Kazakhstan has a promising future in many positions, and we can be one of the world's largest producers of agricultural export products, especially in the production of organic food. Organic farming today is a small but actively developing component of Kazakhstan agriculture. Organic farming covers both crop production and livestock farming and is defined as an "environmental management system for production," which maintains and improves biological diversity, biological cycles, and the biological activity of the soil. Today, a big plus in the digitization of agriculture is the opportunity for consumers to view in detail the history of agricultural products from field to table. There is a full tracking of products from sowing to harvesting, as well as the process of implementation itself. The possibility of selling grain through electronic grain receipts also opens up great opportunities for farmers to sell their goods on the world market.

In order to preserve soil fertility in the region, the question arises of the need to switch to "Organic farming", which bears a rational complex of zonal agritechnologies, aimed not only at preserving the quality of the soil, but also at improving their properties.

Based on the research, we can draw the following conclusion: low level of agriculture is one of the reasons for the fall in soil fertility in the region. To improve and preserve the quality of the soil, it is necessary to observe the law of the return of substances to the soil. Otherwise, the main value of arable land is gradually lost - its fertility. The transition to "Organic farming" in compliance with all principles and laws will entail not only increasing the soil fertility of the region, but will also leave a rich legacy for the future generation. Analyzes showed that 77% of the studied areas contained easily hydrolyzed nitrogen at a low and very low level, mobile phosphorus — by 88%, and humus — at half the area.

In other words, the true causes of low yields and a sharp deterioration in the quality of Kazakhstani grain in recent years have been revealed. And here lies vast reserves of increasing grain fertility. So, according to scientists, only by bringing the content of nitrogen and phosphorus to the level of the norm, it will be possible to increase grain yield by at

least 5–6 hundredweight and increase the proportion of wheat of the 1st and 2nd classes by 3-4 times. If phosphate fertilizers were applied at the proper level, then the ripening of breads could be accelerated by 7–8 days, which is very important in the conditions of such an abnormal year as the current one. In addition, electronic maps of the pilot fields were compiled for contamination of their crops, disease incidence and pests.

REFERENCES

- [1] State program "Digital Kazakhstan", Resolution of the Government of the Republic of Kazakhstan dated December 12, 2017 № 827 https://online.zakon.kz/Document/?doc_id=37168057
- [2] In search of digitalization <http://terrapoint.kz/news/section/33-v-poiskakh-tsifrovizatsii/>
- [3] Precision farming technologies should increase productivity by half – the Ministry of agriculture https://bnews.kz/ru/news/kazahstanskije_tovaro_proizvoditeli_dolzni_golosovat_rublej__za_tochnoe_zemledelie__minselhoz
- [4] To monitor the goods of farmers "from the field to the table" will start in Kazakhstan in 2019 <http://today.kz/news/zhizn/2018-04-06/763537-sledit-za-tovarami-fermerov-ot-polya-do-stola-nachnut-v-kazahstane-s-2019-goda/>
- [5] T. Espolov, "Digitalization of agriculture – a requirement of the new time" <http://kzvesti.kz/kv/thirdband/25528-cifrovizaciya-apk-trebovanie-novogo-vremeni.html>
- [6] Digitalization of agriculture http://polit.ru/article/2018/02/21/sk_digital_farming/
- [7] G.M. Berdykulova, A.I. Sailov, Sh.Y. Kaliashdarova, and E.B. Berdykulov, "The Emerging Digital Economy: Case of Kazakhstan," *Procedia - Social and Behavioral Sciences*, №. 109, pp. 1287-1291, 2014.
- [8] H. Dowding, "The role of the national university in developing nations' digital cultural heritage projects," *OCLC Systems & Services*, vol. 30, issue 1, pp. 52-61, 2014.