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Grain farming informatization indicators

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***Abstract* — The goal of research is to justify the system of economic efficiency indicators in the grain farming, taking into account the modern requirements of agribusiness digitalization, which allows a comprehensive assessment of the economic efficiency factors in the grain farming and to reveal the degree of their impact on the formation of the region grain potential under its informatization. When developing the system, in particular when studying the general principles laid down in the Digital Economy of the Russian Federation program, the monographic method was applied. As a result, the following indicators of grain farming informatization were substantiated: the proportion of agricultural machinery equipped with a satellite navigation system, the proportion of crop yield estimates with GIS systems, the proportion of agricultural machinery for minimal and zero soil preparation, and the data processing speed for the use of quality varieties (for crop rotation) (minutes per 1 processing), the percentage of customers who received information through the site, the processing speed of data on the competitive environment state, (minutes per 1 processing), the number of transactions on the "Zakupki.gov.ru" website (pcs.).**

Keywords — agribusiness, grain, grain farming, informatization, agriculture, digital technologies

I. INTRODUCTION

The level of informatization is an important indicator of the economic development level of a country or region, and many domestic and foreign scientists have studied this topic. Informatization is considered as a developing social phenomenon that has both national and regional features [1].

Since 2017, the Russian government began to pay more attention to digital technologies in agriculture. The Ministry of Agriculture of the Russian Federation proposed the establishment of the "Digital Agriculture" state subprogram, in addition, an analytical center for monitoring the state of agricultural was created within the Ministry [2].

The need to develop and implement innovative agri-food policy in Russia is due to the growing of global food security problems, the solution of which requires fundamental changes in the agri-food complex management [3].

Globalization and rapid development of technologies in the last decades of the XX and early XXI centuries led to the transition from industrial to post-industrial society in developed and many developing countries [4]. The formation of a post-industrial society has been markedly accelerated by the ever-increasing informatization of life. So the shares of the digital economy in the GDP of the G20 countries are at rather high levels, for example, in the UK this indicator reaches 12.4%. Russia is in 8th place according to the growth rate of the digital economy (compared to 2010). Nevertheless, calculations according to the model developed by the A. A.A. Nikonov All-Russian Institute of Agrarian Problems and Informatics show that, given the current state of agriculture without state support, even the transition to industrial technology, which saves significant funds on informatization, will allow reaching an informatization level not exceeding 24% [5].

This problem has led to the fact that at present Russia is only determining the directions of the digital economy development in accordance with the new capabilities of Internet technologies, however, discussions on role of the state in this process have arisen in society [6].

The digital economy is an activity in which the key factor is digital data. It is based on the processing of large volumes of quantitative information, the analysis of which can improve the efficiency of production activities, improve technological solutions and the material base of production, develop systems for processing, storage, sale, delivery of finished products to consumers [7].

The information technology development in the XXI century can significantly accelerate the production of necessary products. Thus, the use of modern developments can significantly increase labor productivity and reduce costs when creating the society needs.

Today, the company is experiencing a new wave of technological development, which was called Industry 4.0 and involves the construction of fully automated production and logistics networks, where machines interact with each other in the production process. The combination of robotics, the Internet, artificial intelligence and 3D printing now allows to build fully mechanized factories for the goods production [8]. Currently, Industry 4.0 is being gradually implemented

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worldwide. The USA, Japan, China and other developed countries has followed by example of Germany [9].

In Russia, up to now 60% of industrial companies work within the Industry 3.0 concept [10]. Therefore, the agricultural production modernization should involve the process of its transition into a higher quality state based on the introduction of a modern innovative model of economic growth of agricultural production, advanced agricultural technologies and scientific developments [11].

The level of agriculture informatization is an important part of the country modernization. It is important to create a reasonable system of indicators for assessing agricultural informatization and to propose an assessment method to promote agricultural informatization [12].

The problems of developing a system of indicators of agricultural informatization have been dealt with by many researchers. S.Yu et al. built a system of indicators for assessing agricultural informatization based on analysis of infrastructure, construction and the development prospects of informatization [13]. Using the bibliometric method, X. Zhang and F. Yang studied the rural informatization policy in China, and concluded that the administrative impact of rural informatization policy is polarized [14]. G.E. Mwalupaso et al. mentioned the problems of agricultural informatization in Zambia [15]. A research of R. Deng et al. examines the non-linear impact of agricultural informatization on agriculture [16]. G. Ya and G. Guohui determined that building a system of assessment indicators for agricultural informatization is a decisive breakthrough to achieve the long-term goal of developing agricultural informatization in China. The system of indicators proposed by them consists of 24 indicators, including infrastructure, technologies and equipment, the level of application and the main level of agriculture informatization, as well as its contribution to the development of agriculture and the political environment [12]. P. Liu and X. Zhang built an agricultural informatization assessment model. The developed model can be used not only to rank orders of various areas in accordance with the level of informatization, but can also implement a qualitative assessment of agricultural informatization in various areas in accordance with the assessment system [11].

Building a system of assessment indicators for agricultural informatization is a decisive breakthrough to achieve the long-term goal of developing agricultural informatization [17].

In view of the above, the goal of research is to justify the system of economic efficiency indicators in the grain farming, taking into account the modern requirements of agribusiness digitalization, which allows a comprehensive assessment of the economic efficiency factors in the grain farming and to reveal the degree of their impact on the formation of the region grain potential under its informatization.

II. METHODS

By order of the Government of the Russian Federation of July 28, 2017 No. 1632-p, the "Digital Economy of the Russian Federation" Program [17] was approved, aimed at creating the necessary conditions for development of the digital economy of the Russian Federation, in which digital data is a key factor of production in all areas of social and economic activity, which increases the country's competitiveness, the quality of life of citizens, ensures economic growth and national sovereignty [18].

The indicators proposed in the Program [17] for assessing the level of digital economy development are generalized, not reflecting the specifics of individual industries. Features of the development of any sector of the economy are determined by various factors. So, the development of agricultural sectors is more dependent on natural and climatic features, the material and technical base development, the improvement of production technologies, etc., which cannot be estimated by the indicators presented in Table 1.

Therefore, to assess digitalization, it is necessary to develop separate systems of indicators for the digital economy development for each sector of the national economy, taking into account the specifics existing in them.

The development of such a system should be based on a single approach and on the general principles laid down in the "Digital Economy of the Russian Federation" Program. Assessment of the digitalization level development should be preformed using end-to-end digital technologies.

TABLE I. INFORMATIZATION INDICATORS ACCORDING TO THE DIGITAL ECONOMY OF THE RUSSIAN FEDERATION PROGRAM

Application area	Indicator
Regarding the digital economy ecosystem	successful operation of at least 10 leading companies (ecosystem operators) competitive in global markets
	successful operation of at least 10 sectoral (industrial) digital platforms for the main subject areas of the economy (including digital healthcare, digital education and the “smart city”)
	successful operation of at least 500 small and medium-sized enterprises in the field of creating digital technologies and platforms and providing digital services
regarding the formation of research competencies and technological process stock	the number of graduates of higher education institutions in areas of training on information and telecommunication technologies
	the number of graduates of higher and secondary professional education with competencies in the field of information technology at the global average level
	proportion of the population with digital skills
regarding information infrastructure	proportion of households with broadband Internet access
	5G and higher coverage in all major cities (1 million people or more)
regarding information security	the proportion of entities using standards for safe information interaction of state and public institutions
	the share of internal network traffic of the Russian segment of the Internet, routed through foreign servers

[a.] Source: [17]

In the "Digital Economy of the Russian Federation" Program developed by the Government of the Russian Federation, the following main end-to-end digital technologies of the national economy are highlighted – big data, neurotechnologies and artificial intelligence, distributed

registry systems, quantum technologies, new manufacturing technologies, industrial Internet, robotics and sensor components, wireless communication technologies, virtual and augmented reality technologies.

III. RESULTS AND DISCUSSION

Historically, indicator systems are being improved in accordance with the development of science and technology – technological paradigms. Now the basis of supply processes in any area of the national economy is information technology, which indicates the formation of a new technological paradigm, which will also be marked by the transformation of existing professions. So, according to the Analytical Center of The Ministry of Agriculture of the Russian Federation, about 40% of professions may disappear by 2030.

Agricultural informatization has a number of important goals:

1. Ensuring the increase of contribution to the economy in 2024 to RUB 5.9 trillion;
2. Ensuring the increase of export earnings of enterprises to $45 billion;
3. Contributing to improving management effectiveness;
4. Contributing to increasing the efficiency of agricultural production and marketing, reducing the cost of production processes;
5. Involvement of new professions workers in agricultural production;
6. Contributing to increasing rural incomes;
7. Creation of conditions for subsidizing the transfer of data from Internet devices as a principle of stimulating the digital solutions implementation.

Due to the quality and operational use of information systems, production costs are reduced by 6–10%, distribution costs - by 7–20%. The effectiveness of information systems use at the company level is expressed in a reduction in inventories by 3-4 times, working capital - by 7-10%. It could be said that informatization has become a mean of optimal use of labor and capital [5]. The economic evaluation for the informatization effectiveness is presented on the example of the technology impact on the "effective ton" of cereal crops (Table 2).

TABLE II. THE TECHNOLOGY IMPACT ON THE "EFFECTIVE TON" OF CEREAL CROPS

End-to-end digital technology	Indicator
New manufacturing technologies Robotics and sensor components	Proportion of agricultural machinery equipped with a satellite navigation system, %
Big data	Data processing speed on the use of quality varieties (crop rotation), min. for 1 processing
Neurotechnology and artificial intelligence; Big data	Proportion of forecasts of changes in soil quality (topography, amount of average annual rainfall), % Proportion crop yield estimates with GIS-systems, %
New manufacturing technologies	Proportion of customers who received information through the site, %
Big data	Processing speed of data on the competitive environment state , min. for 1 processing
New manufacturing technologies Robotics and sensor components	Proportion of agricultural machinery for minimal and zero soil preparation, %
Big data	The number of transactions on the "Zakupki.gov.ru" website, pcs.

In general, it can be noted that according to the forecast, the cost items in the Effective Ton will noticeably decrease. The cost of chemicals in the project structure will be 3.2%, and mineral fertilizers will decrease by 4.2%. The reduction in the individual items share in the total cost will also affect oil products (the expected decrease is 5.4%) and the capital assets maintenance (the expected decrease is 2.6%).

The total savings in monetary form by the "effective ton" of crops will be on average more than 1,500 rubles per ton. Therefore, the planned value of the average cost of 1 ton of grain is 5066.2 rubles per ton.

However, one should take into account the trends in the digital economy formation in the Russian Federation, which makes the formation of a new technological mode that relies on the informatization of economic efficiency factors relevant.

Informatization of agriculture as a whole will include:

- the creation of a Single Information And Management Space of the agro-industrial complex and its transparency;
- improving the quality and operativeness of management decisions;
- increasing the reliability of the agricultural census results;
- expanding the range of services provided in electronic form;
- information security of Systems of the state information support in agriculture;
- cost optimization for the development and maintenance of the State Information Support System in agriculture (Table 3).

TABLE III. DIRECTIONS FOR USING END-TO-END DIGITAL TECHNOLOGIES IN GRAIN FARMING

Cost item	Before informatization, %	After informatization, %
Chemicals	5.1	3.2
Mineral fertilizers	8.7	4.5
Organic fertilizers	0.7	0.7
Oil products	15.6	10.2
Insurance	0.1	0.1
Capital assets maintenance	18.3	15.7

Cost item	Before informatization, %	After informatization, %
Planting material	16.2	16.2
Elite seeds	1.9	1.9
Remuneration	13.2	7.8
Electric power	1.5	1.5
Other expenses	18.6	18.6

At each stage of the economic efficiency formation in the grain farming in terms of the process approach, the factors determining it must correspond to the end-to-end digital technologies specified in the "Digital Economy of the Russian Federation" Program.

Accordingly, a system of indicators of the production and marketing processes informatization level of the grain farming should be presented in the context of the new technological structure development (Table 2).

The proposed system of indicators of economic efficiency in the grain farming, taking into account the modern requirements of digitalization of agribusiness, will allow to determine the main directions for increasing the economic efficiency of the grain farming, while providing for the concentration and specialization of the region, the necessary level of intensification of grain production, a market strategy, and participation in government programs.

IV. CONCLUSION

In general, it should be noted that the developing new technological paradigm in the Russian economy will inevitably be based on the development of digital technologies. Their application in various sectors of the economy is already becoming an important competitive advantage, which allows it to develop in market conditions. Digital technologies in agriculture and especially in grain production in the coming years will serve as the main factor in the country's food security improvement.

The tasks of the digital transformation of agriculture outlined by the Ministry of Agriculture of the Russian Federation include the following areas:

- conducting scientific, technological and economic expertise in priority areas of development and research and development needs for digitalization implementation in agriculture;
- the integration of the online platform functionality, which provides agricultural producers with access to state and banking products, in the structure of a specialized portal through user's "Personal Account";
- providing broadband Internet coverage for agricultural land;
- increasing the effectiveness of interaction between participants and with the state by transiting to a digital data exchange format to reduce types of reporting;
- formation of proposals for the adjustment of legal acts and regulatory and technical requirements for creation of information support system for the agro-industrial complex;
- the formation of mechanisms and support measures for the introduction of digital platforms in the direction of "end-to-end" technologies in agriculture;
- ensuring traceability of agricultural products (tags, chips, identifiers, technologies, devices, systems);
- providing a package of personal technological solutions (matrix) through user's "Personal Account";
- stimulating the use of online trading platforms and systems for promoting agricultural products;
- the formation of educational and methodological complexes (standards, program methods) of training;
- technological inventory of equipment [19].

Informatization as a process that demonstrates the transition to a new type of civilization, characterized by the strongest scale influence on society, affecting all levels, layers of life, requires the development of a new methodology for understanding both the very phenomenon of informatization and the potential and content of its social regulation [18].

Realization of these areas is possible with implementation of innovative policies, which should include the following activities:

- support for high-tech innovative programs;
- stimulation of capital providers investing in high technology production;
- providing financial support to agricultural producers;
- competitive system for selecting innovative projects with the aim of their subsequent implementation in agricultural production.

It is important to consider that each organization has different development conditions and, as a result, this affects the efficiency of its business activities. When studying the economic efficiency of the organization, high priority should be paid to the factors that influence it. In one case or another, various factors are decisive. So, for organizations located in the risky farming zone, natural factors will have the greatest impact. In turn, small organizations are more likely to be affected by a lack of productive resources. Therefore, when assessing the effectiveness level of a grain producing organization, a set of indicators should be used.

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