Digitalization of agriculture in Russia: a regional aspect

E S Vorobeva, N Z Goncharova, A E Kovaleva and O V Vorobev
Smolensk State Agricultural Academy, 10/2, Bolshaya Sovetskaya Str., Smolensk, 214000, Russia
E-mail: elenasn@yandex.ru

Abstract. The article summarizes the results of the study of digitalization of agricultural processes in all regions of Russia, highlights the most successful and lagging regions, notes the relationship between the level of investment in agriculture, the power supply of agricultural workers and the introduction of digital technologies. Conclusions are made about the need to integrate individual digitized operations into a single system at the regional level. The results of the study made it possible to highlight the most problematic issues of digitalization of the agrarian sector, its disadvantages and advantages and, on this basis, propose directions for the further development of regional digital systems.

1. Introduction
The article summarizes the results of the study of digitalization of agricultural processes in all regions of Russia, highlights the most successful and lagging regions, notes the relationship between the level of investment in agriculture, the power supply of agricultural workers and the introduction of digital technologies. Conclusions are made about the need to integrate individual digitized operations into a single system at the regional level. The results of the study made it possible to highlight the most problematic issues of digitalization of the agrarian sector, its disadvantages and advantages and, on this basis, propose directions for the further development of regional digital systems.

2. Materials and methods
The assessment of the state of digitalization of domestic agriculture at the regional level was carried out on the basis of the works of domestic and foreign scientists, the Internet, departmental statistical collections by region, data from periodicals, materials of scientific and practical conferences, advertising materials. The classical research methods were used: a systematic approach, structural and logical analysis, elements of the statistical method.

3. Results and Discussion
The theoretical foundations of the problem are presented in the works of domestic and foreign scientists, devoted mainly to the digitalization of industry, finance, trade, and management. A number of scientists believe that precision farming is an integrated production system, which is based on the achievements of IT technologies, which provides automatic control and regulation of agricultural machinery and equipment, as well as computerization of all agricultural production management processes in order to optimize agricultural technologies and stabilize the productivity of plants and animals [1-8]. Another group of scientists considers the digital economy in the agricultural sphere to be one of the types of commercial activities in the electronic space [7-10]. A number of authors define the digital economy as "a model reflection of economic relations in production, distribution, exchange
and consumption based on information and communication technologies" [3; 8]. The regional aspect of the problem of digitalization is highlighted in the works of scientists of the Kuban State Agrarian University [1].

The specific features of agricultural production are reflected in the possibilities and problems of its digitalization, since all aspects of the industry have a huge number of digital characteristics, the processing and analytical comprehension of which dictates the need for widespread use of digital technologies [4; 6]. The digitalization of agriculture makes sense only under the condition of complete mechanization and automation of production processes, when timely and timely information will help to adjust the course of individual working periods and, on this basis, to carry out point optimization of individual cost items and ultimately reduce the production cost of individual crop and livestock products [5; 9].

The automation and digitalization of domestic agriculture requires a high level of energy equipment and significant investments, and according to experts from the Ministry of Agriculture, investments in fixed assets at enterprises of the Russian agro-industrial complex have been steadily decreasing since 2015. At the same time, a characteristic feature of Russian agriculture is a huge territorial extent with different soil and climatic conditions, different levels of favorableness for the development of agriculture. The regions of Russia are also unequal in terms of the level of equipping with energy resources and investments (table 1).

| Federal districts | Energy power, h.p. | Investments in agriculture, thousand rubles |
|-------------------|-------------------|--------------------------------------------|
|                   | average | minimum | maximum | average | minimum | maximum |
| Central           | 76.7    | 55.9    | 116.3   | 197.7   | 16.1    | 322.6   |
| Northwestern      | 60.1    | 27.6    | 89.8    | 167.9   | 37.4    | 393.2   |
| Southern          | 86.1    | 52.4    | 117.2   | 64.1    | 24.6    | 114.7   |
| North Caucasian   | 69.0    | 25.4    | 98.6    | 34.7    | 8.0     | 86.6    |
| Privolzhsky       | 81.4    | 61.2    | 115.0   | 69.9    | 20.5    | 232.3   |
| Ural              | 71.9    | 54.3    | 109.4   | 88.9    | 48.0    | 132.2   |
| Siberian          | 94.8    | 62.3    | 116.9   | 68.5    | 12.1    | 136.5   |
| Far Eastern       | 89.8    | 46.0    | 139.2   | 96.9    | 8.1     | 417.5   |
| Average across the Russian Federation | 80.2 | 25.4 | 139.2 | 96.0 | 8.0 | 417.5 |

Table 1. Energy capacity and investment in agriculture per employee by federal districts of the Russian Federation, 2018.

The differences in the power-to-weight ratio in federal districts from the average Russian level are -25.0 + 18.2%, while there are threefold differences between the minimum and maximum values for individual regions. Regions differ to an even greater extent in terms of the relative level of investment: the Central Federal District exceeds the North Caucasian District by 5.7 times, and the differences between the maximum and minimum levels are 4.7 - 51.5 times. Thus, the regions of the Russian Federation initially have unequal conditions for the mechanization of production processes in agriculture, and, consequently, for the digitalization of the agrarian sector. In this regard, the interregional differences in the achieved results are quite significant (tables 2 and 3) [1].

According to the Ministry of Agriculture, the level of digitalization in 85 constituent entities of the Russian Federation shows a high level of development of IT technologies in 20% of regions, an average - 29%. A survey of the heads of agricultural enterprises in Russia, conducted by the Center for Forecasting and Monitoring of the Kuban State Agrarian University, made it possible to establish that 33% of managers are restrained in their attitude to digital technologies because of their high cost; 15% doubt the functionality and reliability of technologies; 9% associate the introduction of digital technologies with high costs for personnel retraining [1]. The leader in terms of coverage of subjects among the federal districts is the Ural, in which all regions of the region have mastered digital
technologies, they are used in crop production on an area of about two million hectares, in cattle breeding, and about 300 thousand heads of cattle are covered by digital. The regions of the Central, Volga and Siberian Federal Districts are the leaders in the number of mastered technologies.

Table 2. Indicators of the use of digital technologies in agriculture by federal districts of the Russian Federation.

| Federal districts   | Plant growing number of SHO | Livestock number of SHO | area, ha | livestock |
|--------------------|-----------------------------|--------------------------|---------|----------|
| Central            | 18                          | 12                       | 3083    | 141      | 324      |
| Northwestern       | 11                          | 6                        | 1128    | 85       | 246      |
| Southern           | 15                          | 5                        | 1716    | 60       | 113      |
| North Caucasian    | 5                           | 3                        | 113     | 68       | 95       |
| Privolzhsky        | 24                          | 7                        | 2200    | 260      | 305      |
| Ural               | 13                          | 9                        | 1972    | 167      | 281      |
| Siberian           | 20                          | 8                        | 1798    | 102      | 296      |
| Far Eastern        | 9                           | 3                        | 965     | 103      | 141      |

Note: 1 - agricultural organizations.

Table 3. Regions of the leader and outsiders in the use of digital technologies in agriculture by federal districts of the Russian Federation.

| Federal districts | Regions are leaders                           | Regions are outsiders                          |
|-------------------|----------------------------------------------|-----------------------------------------------|
| Central           | Belgorod, Bryansk, Kaluga, Lipetsk, Tambov, Kursk regions | Ivanovskaya, Kostroma, Tver regions |
| Northwestern      | Murmansk, Novgorod, Pskov regions, Republic of Karelia | Arkhangelsk, Murmansk |
| Southern          | Krasnodar Territory, Volgograd Region         | Republics of Adygea, Kalmykia, Crimea          |
| North Caucasian   | Stavropol region                             | All republics of the district                 |
| Privolzhsky       | Republics of Tatarstan and Bashkortostan, Samara region | Kirovskaya, not |
| Ural              | Sverdlovsk, Tyumen regions                   | Krasnoyarsk Territory, Irkutsk, Kemerovo, Omsk, Tomsk regions, all republics |
| Siberian          | Altai region                                 | Jewish Autonomous Region, Magadan and Sakhalin Regions, Kamchatka and Primorsky Territories |
| Far Eastern       | Amur region                                  |                                               |

4. Conclusion
The generalization of the research results allows us to conclude that the digitalization of agriculture in the regions of Russia is at the very beginning of the “digital chain”. In our opinion, the following problems of digitalization of the agrarian sector in the regions should be highlighted, the solution of which will allow transferring the coverage of the industry with IT technologies to a new level:

- Each region of Russia develops its own program, taking into account local characteristics, opportunities and problems, i.e. it can be stated that there is no uniform strategy for all
regions. Regions with a high level of agricultural production are among the leaders in digitalization, and for outsider regions, the main task is to increase production and financial indicators, and digitalization is a secondary task;

- A prerequisite for digitalization is the creation of an integral system of machinery and equipment for crop and livestock production according to the principle of "smart field", "smart greenhouse", "smart farm", because only in this case digital technologies will help to quickly influence technological processes and optimize the elements of production costs;

- Crop production in terms of the number of digital technologies used significantly exceeds animal husbandry, which is naturally related to the specifics of the industry: if in crop production it is possible to automate and digitize individual work processes, then in livestock production - the entire production process, while integration into a single system and integration with 1C "Accounting", Which will close the" digital chain ";

- The main problem of digitalization of the agrarian sector is the human factor: the lack of highly qualified personnel. According to IT specialists, the implementation of digital technologies takes an order of magnitude more time than their development. In this regard, regional universities need to move to mass training of specialists with equivalent knowledge in agriculture and information technology, who are able to work digitally in on-line mode. first of all, agronomists-economists, agricultural ecologists, operators of automated agricultural machinery, city-farmers, GMO-agronomists, agro informatics, agro cybernetics with systems thinking will be in demand;

- The introduction of digitalization systems is sabotaged by agricultural producers due to the transparency of the processes and the exclusion of the possibility of theft and waste of resources;

- Digitalization is financed by the own funds of agricultural producers, therefore, additional financial support is needed, especially for small and medium-sized enterprises, while there are a lot of federal support measures, but they do not always reach specific enterprises;

- To generalize, analyze and disseminate best practices in the federal districts, it is advisable to create centers of competence in the field of digitalization and training centers for training employees of large and small businesses.

- A deterrent to digitalization is the fear of manufacturers that information on the production and financial activities of the enterprise will fall into the hands of unscrupulous counterparties or competitors;

- The conservatism of agricultural workers and the lack of reliable information about the availability of inexpensive and even free IT programs, in connection with which it is necessary to develop targeted regional programs for subsidizing digitalization in large and farms.

References

[1] Truflyak E V 2019 Monitoring and forecasting in the field of digital agriculture based on the results of 2018 (Krasnodar: KubSAU) 100

[2] Chen Y, Chao K and Kim M 2002 Machine vision technology for agricultural applications Computers and Electronics in Agriculture 36 173–191

[3] Fillingham Davina 2014 Precision agriculture: In the field and beyond the farm gate The application of precision farming technologies for rural land and asset management. A Nuffield Farming Scholarships Trust 107

[4] Dale Steele Analysis of Precision Agriculture Adoption & Barriers in western Canada 2017 (Producer Survey of western Canada: Canada) 53

[5] Kise M, Zhang Q and Rovira Ms F 2005 A Stereovision-based crop row detection method for tractor-automated guidance Biosystems Engineering 90(4) 357-367

[6] Precision agriculture and the future of farming in Europe 2016 (Technical Horizon Scan - Brussels, European Union) 274
[7] Robotrends Retrieved from: http://robotrendsru
[8] Redmond Ramin Shamshiri, Cornelia Weltzien, Ibrahim A Hameed, Ian J Yule, Tony E Grift, Siva K Balasundram, Lenka Pitonakova, Desa Ahmad and Girish Chowdhary 2018 Research and development in agricultural robotics: A perspective of digital farming. *Int J Agric and Biol Eng* **11**(4) 14

[9] Rovira-Ms F, Zhang Q and Reid J 2005 Creation of Three-dimensional Crop Maps based on aerial stereoimages. *Biosystems Engineering* **90**(3) 251–259

[10] Hemmat *Improving field management by machine vision - a review* Retrieved from: http://wwwcigrjournalorg