Using digital agricultural production based on navigation and information systems

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Annotation. Due to the peculiarities of the agro-industrial complex of the Russian Federation, the digitalization of agriculture has a number of significant features. At its core, these technologies are innovative, one of the most important functions of which is intellectual. There is a need to clarify the concepts of "transfer of enterprises of all forms of ownership of agro-industrial complex to the figure": is the process of determining the feasibility of implementation of digitalization and robotics, the purchase of innovative technologies in agribusiness companies, adaptation of the technology and production system, operation and determination of the effectiveness of its use in a specific production, taking into account soil-climatic conditions in the area of implementation.

Enterprises of all forms of ownership in agriculture operate in conditions of acute shortage of qualified personnel, low attractiveness of labor in the crop and livestock industries, a decrease in the life expectancy of the rural population and the migration outflow of residents of rural settlements to large cities. Statistics show that the population of rural settlements has decreased by 2.3 million people since 2000, and amounted to 37.1 million as of January 1, 2014. Due to the optimization of rural schools and the lack of qualified medical care, it is assumed that these trends will continue and even strengthen. These circumstances call for the use of labor-saving technologies, including digital, intelligent and robotic [1,2,3].

When implementing digitalization in the organization of agriculture, it is necessary to take into account regional characteristics and specifics of specific branches of agricultural production [4].

Regional features of digitalization and robotization may be related to the peculiarities of the region's development. These features include the level and conditions of socio-economic development of the region, the level of urbanization, infrastructure development, demographic trends, the competitiveness of the agricultural sector in attracting labor in comparison with other industries, etc.

The industry features that cause the need for digitalization and robotization may be related to the need to perform monotonous repetitive processes, the presence of heavy, dangerous and harmful types of activities for the creation of agricultural products in the agricultural sector. An important condition
for the robotization of processes in agriculture is the ability to compile certain algorithms that underlie the functioning of robotics.

Robotics can be used in animal husbandry for milking animals, cleaning manure, shearing sheep, etc., in crop production for sowing crops, spraying plants with pesticides and fertilizers, weeding weeds, controlling the germination of soil under crops, etc., in auxiliary production for monitoring agricultural land, sorting and packaging products, etc. [4].

The transition of enterprises of all forms of ownership of agriculture to digital, intelligent systems and robotics is caused by the need for a number of changes:

- optimization of labor productivity in agricultural enterprises. In the case of correctly selected robotic systems, labor productivity increases by several times or by an order of magnitude in comparison with manual production [5,6];
- increase of safety and improvement of working conditions at the enterprises of the agro-industrial complex. The use of robotics is very effective in harmful production. In agriculture, this includes working with pesticides, fertilizers, fuels, lubricants, and animal and poultry waste.
- bringing the quality of agricultural products to high, competitive standards [7,8,9,10].
- creation of additional jobs in agriculture-related industries.

The Republic of Tatarstan has accumulated a lot of experience in using digitalization in LLC "agro-industrial complex "FOOD PROGRAM", especially in the agrosignal system – an online service for accounting and monitoring the progress of agricultural work in the crop production industry.

Implementation goals and objectives

1. Interactive map of fields with work history for each field
2. Quality control processing field, the flaws, the speed of movement of vehicles
3. Accounting for field and transport work
4. Data from computers on equipment: seeding rate on seeders, liquid consumption in sprayers, engine hours, fuel, etc.
5. Accounting for the full cycle of movement of fuel and lubricants (columns, fuel trucks, tanks in equipment)
6. Control of the complete chain of movement of finished products (combines, bunkers, transporters, trucks, weight rooms, warehouses)

The transition of agriculture to digital technologies should be targeted. The following goals are pursued:

— the most economical consumption of all necessary resources for production, compared to traditional technologies;
- reduction of harmful emissions to the atmosphere and soil, significant reduction of soil compaction in comparison with traditional technologies due to spot and precise tillage in crop rotations;
- reducing the need for labor resources, in order to save on the remuneration of permanent and employees;
- reducing the impact of the human factor on technological processes and production results, including non-compliance with technology, theft, etc.;
- optimization of costs for labor protection and safety, prevention of occupational diseases;
- maximum obtaining of objective information for making competent, operational management decisions;
- economical use of seeds, fertilizers, and pesticides through the use of precision and spot farming technologies;
- improving the quality of products through the introduction of innovative technologies, as well as quality control of technological operations.

References

[1] Skvortsov E. A., Skvortsova E. G., Sandu I. S., iovlev G. A. Transition of agriculture to digital, intelligent and robotic technologies // Regional economy. - 2018. - Vol. 14, issue 3. - P. 1014-1028

[2] Blinova T. V., Bylina S. G. Scenario forecast of the rural population of Russia in the medium term // Regional economy. - 2014. - № 4. - P. 298-308.

[3] Akimov A. Demographic explosion, population aging and labor-saving technologies. In the Interaction in the twenty-first century. // World economy and international relations. - 2016. - Vol. 60. - Issue 5. - P. 50-60.

[4] Skvortsov E. A. Improving the efficiency of robotization of agriculture: author. dis. ... Cand. Econ. science / Usau-Yekaterinburg, 2018. - 24 p.

[5] Kashapov N. F., Nafikov M. M., Yakushkin N. M., Nigmatzyanov A. R. State of technical level of domestic agricultural machines. Innovative engineering technologies, equipment and materials-2018 (ISTC "IMTOM-2018") Materials of the IX scientific and technical International conference. 2018. Pp. 305-309.

[6] Kashapov n. f., Nafikov M. M., Gazetdinov M. K., nafikova M. M., Nigmatzyanov A. R. comparative evaluation of various machines for seeding sorghum VGD conference series: materials Science and technology Ser. "International scientific and technical conference on innovative engineering technologies, equipment and materials 2016, ISTC-IETEM 2016" 2017. P. 012033

[7] Kashapov N. F., Nafikov M. M., Gilmanshin I. R., Gazetdinov M. H., nafikova M. M., Nigmatzyanov A. R. energy-Saving technologies of sugar sorghum cultivation. Innovative engineering technologies, equipment and materials-2016 (ISTC " IMTOM-2016") Materials of the International scientific and technical conference. 2016. Pp. 316-321.

[8] Kashapov N. F., Nafikov M. M., Gilmanshin I. R., Gazetdinov M.Kh., Nafikova M. M., Nigmatzyanov A. R. Energy-saving technologies of cultivation of sugar sorghum. IOP conference series: materials Science and engineering Ser. "International scientific and technical conference on innovative engineering technologies, equipment and materials 2016, ISTC-IETEM 2016" 2017. P. 012032.

[9] Kashapov N. F., Nafikov M. M., Nigmatzyanov A. R., Gainutdinov I. G. (2019). State of the technical level of domestic agricultural machinery. IOP conference series: materials Science and engineering. 570. 012047. 10.1088/1757-899X/570/1/012047.

[10] Kashapov N. f, Nafikov M M, Gazetdinov m x, Gazetdinov sh M, Nigmatzyanov a R. Modern problems of digitalization of agricultural production / IOP conference series: materials Science and engineering.(2019) 012048