

Analysis of the digitalization efficiency in agricultural complex in the Republic of Tatarstan

Gulnara Dzhaudatovna Krupina^{1,*}, Niyaz Azatovich Safiullin¹, Svetlana Sergeevna Kudryavtseva², Louisa Nizamovna Savushkina¹, and Chulpan Malikovna Kurakova¹

¹Kazan State Agrarian University, 420015 Kazan, Russia

²Kazan National Research Technological University, 420015 Kazan, Russia

Abstract. The article provides an analysis of the current state of the agro-industrial complex of the Republic of Tatarstan in the digital economy. Indices of Russia's position in readiness for the digital economy are given. The priority directions of digitalization of agriculture in the Republic of Tatarstan are described. Practical experience of implementing the elements of the digital economy in the agricultural sector of the region is given. The analysis of strengths and weaknesses, opportunities and threats in the digitalization of agriculture is presented. Measures are proposed to increase the efficiency of digital transformation in the Republic of Tatarstan.

1 Introduction

The digital economy transition is seen as a main reason of economic growth. According to the Ministry of Agriculture of the Russian Federation, digital technologies in the agro-industrial complex allows increasing the agricultural production profitability in terms of optimization of costs and more efficient

allocation of funds. The introduction of the digital economy allows reducing costs by at least 23% with the introduction of an integrated approach.

According to the Government's Digital Economy of the Russian Federation program, Russia ranks 43rd in terms of developing the digital economy by a significant margin from dozens of leading countries, such as Singapore, Finland, Sweden, Norway, the United States of America, the Netherlands, Switzerland, Great Britain, Luxembourg and Japan.

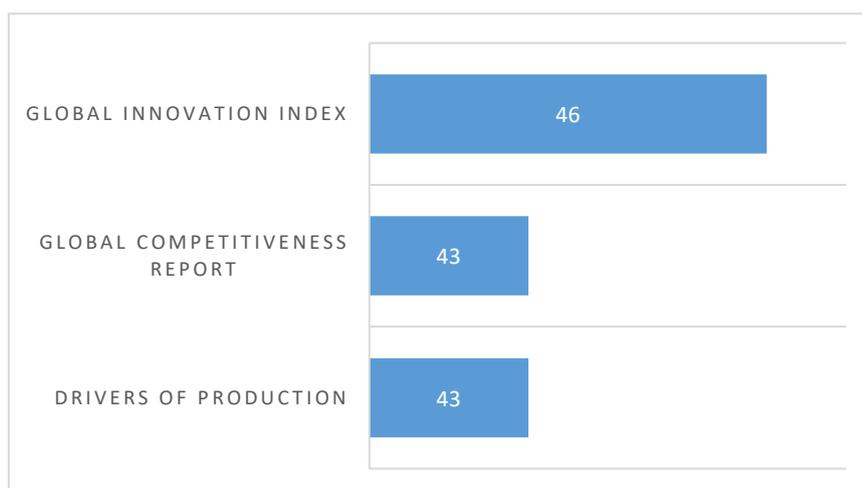


Fig. 1. Russia's place in international economic development rankings

Such a significant lag in the development of the digital economy from world leaders is explained by gaps in the regulatory framework for the digital economy and an insufficiently favorable environment for doing business and innovations and, as a result, the low level of use of digital technologies by business structures.

According to the Ministry of Agriculture of the Russian Federation, the leaders in the pace of introducing digital approaches in agriculture are Altai and Krasnodar Territories, Kursk, Lipetsk and Samara Regions, the Republic of Bashkiria and the Republic of Tatarstan.

* Corresponding author: upravshp@yandex.ru

2 Results

The level of agro-industrialization digitalization in the regions was assessed by such indicators as testing pilot solutions and their replication, full-featured use of e-Government and new digital technologies, amending regulations that ensure the implementation of the departmental project "Digital Agriculture", unification and application of centralized solutions, and there is also the possibility of connecting existing regional systems

with a high level of development of IT technologies in agriculture.

The agricultural sector represents a significant sphere of the national economy and plays an important role in the economy of the Republic of Tatarstan. The development of the agro-industrial complex still remains one of the strategic priorities of the economic and social policies in the Republic of Tatarstan. Up to 10 percent of the budget of the Republic of Tatarstan is allocated to support the agricultural sector.

Table 1. Main indicators of agriculture of the Republic of Tatarstan

	2015	2016	2017	2018
Agricultural products				
total, million rubles	211 810	229 813	235 297	216 003
as a percentage of the previous year, in comparable prices	104.1	104.9	104.9	97.1
including products:				
plant growing, million rubles	104100	117153	118965	101699
as a percentage of the previous year, in comparable prices	107.2	109.5	109	92.3
livestock, million rubles	107 710	112 660.1	116 333	114 304
as a percentage of the previous year, in comparable prices	101.3	100.5	100.7	101.8

The Republic is on the top three leaders among the constituent entities of the Russian Federation in terms of gross agricultural output and fully satisfies the needs of the population in basic food products. The cheapest minimum set of food products among the subjects of the Russian Federation belongs to the Republic of Tatarstan.

The main arguments in support of the digitalization of agricultural production in the Republic of Tatarstan are the need to fulfill the following problematic tasks related to Russia's lagging behind the advanced countries of the world:

- increase in the quantity and quality of the crop;
- minimization of capital investments;
- reducing labor intensity and increasing agricultural productivity;
- reduction of harmful effects on the environment;
- reduction of dependence on the human factor in agriculture and yield deviation.

Based on the tasks facing the agro-industrial complex in the Republic of Tatarstan, the following are the main priorities in implementing digitalization of agriculture:

- the focus of the entire agro-industrial complex management system on accelerating its digital transformation, creating conditions for increasing the financial sustainability of agricultural producers and the social development of rural areas;
- attracting industry unions, associations and self-regulatory organizations on a voluntary basis to participate in the formation and implementation of the state agricultural policy in the field of digitalization;
- meeting the needs of the agro-industrial complex with qualified IT staff;
- the introduction of modern information technologies in the process of public administration in the field of agriculture;
- increasing the effectiveness of departmental control over the processes of informatization of the industry.

All territorial governing bodies and most large organizations of the agro-industrial complex in the Republic of Tatarstan are connected to the State Integrated Telecommunications System with unified email servers, a system of portals and a document management system, conducting quick interaction and solving tasks.

The Ministry of Agriculture and Food of the Republic of Tatarstan and the State Unitary Enterprise of the Republic of Tatarstan "Republican Information and Computing Center of the Ministry of Agriculture and Food of the Republic of Tatarstan" introduced an information-analytical system for monitoring agricultural production indicators with online input directly from all municipal regions of the republic.

The participants in the implementation of modern information technologies are regional and municipal authorities and administrations, non-governmental organizations engaged in the agricultural sector and providing a consolidated solution to the problem.

The measures taken helped to create the prerequisites for the implementation of modern information technologies and the further formation of state information resources in the field of agro-industrial complex management.

The Republic of Tatarstan is actively using digitalization tools and information technology to support agricultural production.

So, for example, for agricultural land observation and monitoring there have been used drones in the agricultural sector of the republic. Such devices were received by specialists of agricultural and food departments in Laishevsky, Arsky, Muslyumovsky, Bugulminsky, Pestrechinsky, Almetyevsky, Tetyushsky and Chistopol regions. Drones can conduct high-quality video shooting from a highest view and provide information on the state of crops. Unmanned aerial vehicles are also used as part

of a republican project to create a geographic information system for the agro-industrial complex of the republic. Aircraft make a map of the republic's crops, accurately

determining the boundaries of the fields. To date, the boundaries of the fields have been fully identified, and the field passports of 2018 are 57% filled.

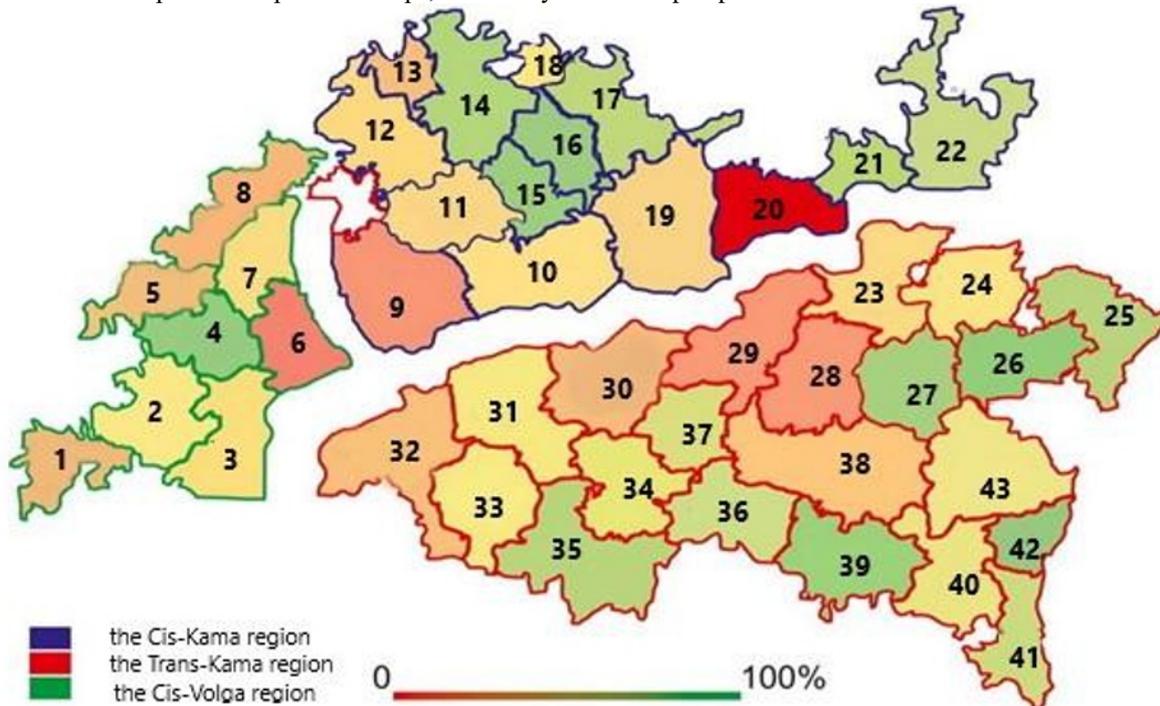


Fig. 2. Completion of field passports by municipal areas, Republic of Tatarstan: 1 – Drozhanoe 35%, 2 – Buinsk 56%, 3 – Tetushi 52%, 4 – Alastovo 85%, 5 – Bolshie Kaibitsy 39%, 6 – Kamskoe Ustie 12%, 7 – Verkhniy Uslon 51%, 8 – Zelenodolsk 34%, 9 – Laishevo 21%, 10 – Rybnaya Sloboda 54%, 11 – Pestretsy 49%, 12 – Vysokaya Gora 50%, 13 – Atninskiy 38%, 14 – Arskiy 78%, 15 – Tuliachi 84%, 16 – Bogatye Saby 84%, 17 – Kukmorskiy 75%, 18 – Baltasi 57%, 19 – Mamadyshskiy 47%, 20 – Elabuzhskiy 0%, 21 – Mendeleevskiy 62%, 22 – Agryz 76%, 23 – Naberezhnye Chelny 51%, 24 – Menzelinsk 55%, 25 – Aktanysh 77%, 26 – Muslimovo 86%, 27 – Sarmanovo 81%, 28 – Zainsk 23%, 29 – Nizhnekamsk 22%, 30 – Chistopol 38%, 31 – Alexeevskiy 59%, 32 – Spasskiy 39%, 33 – Alkeevskiy 59%, 34 – Aksubaev 63%, 35 – Nurlatskiy 77%, 36 – Cheremshanskiy 70%, 37 – Novosheshminsk 68%, 38 – Almetievskiy 42%, 39 – Leninogorskiy 83%, 40 – Bugulma 63%, 41 – Bavly 71%, 42 – Utazy 86%.

Currently, the Republic of Tatarstan is creating a geographic information system for the agro-industrial complex. Its goal is to increase the efficiency of agricultural production, monitoring, a comprehensive assessment and analysis of the state of the agricultural sector in order to forecast and make effective management decisions.

There is a unified information system of the agro-industrial complex of the republic with a functional structure of digital agriculture management introduced in Tatarstan. The project is intended for the effective use, planning and control of agricultural production stages, as well as the observation and monitoring of agricultural land.

The GIS system of the agro-industrial complex of the Republic of Tatarstan will become an effective assistant for specialists and managers at the municipal and republican stages in the operational solution of the tasks set, will allow keeping records and monitoring the state of all agricultural lands in the Republic of Tatarstan, increasing the productivity of land, including through the involvement of agricultural land. It can be entered into turnover and will become a real assistant to agricultural producers in increasing the profitability of production.

The training of highly qualified personnel for the agro-industrial complex takes place at the Mechanization

Institute of the Federal State Budgetary Educational Establishment of the Kazan Agrarian University in the form of annual advanced training courses for engineering and technical personnel of district agricultural administrations and agricultural producers of the republic.

The audience is attended by experienced university teachers, key dealers and specialists of the Ministry of Agriculture and Food of the Republic of Tatarstan. The training program includes theoretical and practical classes on:

- technologies for the operation and restoration of units and assemblies of agricultural machinery, as well as livestock equipment;
- methods of reducing costs during the operation of the machine and tractor fleet;
- modern systems of digitalization of agricultural production and labor protection.

Agricultural producers are also actively involved in the digitalization of business processes. For example, the “Agrosila” holding pays special attention to the technical modernization of the equipment of enterprises and agricultural companies, implements such programs as:

- introduction of sugar beet type of “Amity”, cultivation technology tools;
- Precision farming, including building up an information base on the fields of the holding,

- agrochemical field inspection and differential fertilizer application, the expansion of the use of automated control systems for equipment;

- The “smart farm” project, aimed at digitalizing livestock, as well as the maximum orientation of the meat sector to the production of high value-added products.

In addition, as part of a joint project with the British company Househam, a new project for the acquisition of self-propelled sprayers is being implemented. Specialists of “Agrosila” are testing them on the fields of the Holding, and until 2021 they planned to open a production facility for the assembly of innovative sprayers in the Republic of Tatarstan.

“Agrosila” Holding is a leading agricultural producer in the Volga region. A vertically integrated holding, including enterprises for the cultivation of grain crops, the production of poultry, sugar and dairy products. The enterprises included in its composition are important elements of the development of the agricultural sector of Tatarstan. The “Chelny Broiler” company occupies 65% of the poultry market in the Republic of Tatarstan, Zainsky Sugar - 51% of the sugar market. A seed plant produces seeds for agricultural companies of the Republic, a feed mill provides compound feed for meat and dairy production.

The Ministry of Agriculture and Food of the Republic of Tatarstan, the Republican Information and Computing Center and the International Consumer Cooperative Digital Artel Agrarium is developing an e-commerce

system that is designed to organize the trading activities of farmers and agricultural producers.

The main difference and advantage of the system is the ability for farmers to sell their products directly to real customers, bypassing intermediary firms and retail chains. The e-commerce system allows peasant farmers to significantly reduce costs and sell products to consumers according to the right prices in the shortest possible terms. In addition, the system’s functionality allows for constant quality control of production at all stages, to control the fattening, growth and health status of young animals in real time until the stage of meat processing and delivery to the buyer.

However, these measures are not enough for a radical digital transformation of the industry. The authors conducted a SWOT analysis of the digitalization of agriculture in the Republic of Tatarstan

According to a combination of elements of a complicated SWOT analysis, the following specific strategies are formed:

1. The combination of "opportunities - strengths" form a development strategy (OS).
2. The combination of “opportunities - weaknesses” forms a strategy for internal transformation (OW).
3. The combination of “threats - weaknesses” is seen as a limitation of strategic development (TW).
4. The combination of “threats - strengths” is used as a strategy of potential benefits (TS).

Table 2. SWOT analysis of digitalization of agriculture of the Republic of Tatarstan

Strengths (S)	Weaknesses (W)
S1 - reducing the cost of agricultural production S2 - improving the quality of agricultural products S3 - increase productivity and productivity S4 - reducing the complexity of agricultural production S5 - receipt by all market participants of relevant and reliable information	W1 - integration with all other business processes at agricultural enterprises W2 - lack of necessary knowledge among managers and employees of enterprises W3 - Disinterest in digitalization by small farmers and personal subsidiary plots W4 - high costs for automation and robotization of processes W5 - lack of information on existing and emerging digital technologies
Features (O)	Threats (T)
O1 - increasing the competitiveness of the industry in the global market O2 - decrease in agricultural import dependence equipment, their hardware and software O3 - promotion of automation, robotics, intelligent machine technology O4 - risk reduction and adaptation to climate change O5 - simplification of the supply chain of products from the field to the consumer	T1 - lack of highly qualified employees, primarily IT specialists and engineers T2 - lack of financial support from the state T3 - lack of a ready-made integrated solution on the market that would ensure automation and transparency of all business processes T4 - the need for import substitution of component and instrument base T5 - the need to ensure a stable (high-quality) navigation and cellular signal throughout the Republic of Tatarstan due to large the scale of the territories and the diversity of soil and climate zones

3 Discussion

As a result of the introduction of information technologies in the production process, production costs will be reduced, as digital technologies will optimally and cost-effectively organize business processes at enterprises, which in turn will increase their competitiveness in the agricultural market (S1O1), simplify supply chains from producers to consumers, as there will be no need for intermediaries (S1O5). Improving the quality of agricultural products through lean manufacturing technologies will also increase the industry's competitiveness in the global market (S2O1).

The opportunities identified as a result of the SWOT analysis can reduce the influence of the weaknesses of the problem studied. With the constant and massive promotion of automation, robotics, intelligent machine technologies in the business processes of agricultural enterprises, their implementation cost will gradually decrease (O3W4). The same processes, while reducing costs, will help small farmers and owners of private farms to achieve digital transformation (O3W3).

However, the identified threats, such as a shortage of highly qualified employees, primarily IT specialists and engineers, as well as the need for import substitution of component and instrument base can lead to a lack of necessary knowledge among enterprise managers and workers and lead to high costs for automation and robotization of processes (T1T4W2W4).

Identified strengths can in turn neutralize the considered threats. Upon receipt of relevant and reliable information by all market participants, it will help agricultural organizations quickly find highly qualified employees, especially IT specialists and engineers (S5T3). Reducing the cost of agricultural production will gradually abandon the financial support of the state or reduce the amount of such assistance. (S1T2)

4 Conclusion

The intensive and rational implementation of digitalization and the Internet into the agriculture of the Republic of Tatarstan undoubtedly turns the industry into a high-tech business due to explosive growth in productivity and reduction of non-productive costs, which are attributes of "Agriculture 4.0".

"Agriculture 4.0" includes all available means of mechanization and automation of production, supplemented by the "Internet of things" (when machines and equipment exchange data and commands with each other without human intervention), big data and even more subtle electronics that penetrate into all areas of agricultural production.

References

1. A.S. Gusev, G.A. Beznosov, N.V. Ziablitskaia, M.V. Kholmanskikh, L.A. Novopashin, L.V. Denyozhko, A.A. Sadov, *An analysis of research areas in precision agriculture*, Int. Transaction J. of

Engineering, Management, & Applied Sciences & Technologies, **10(10)** (2019) DOI: 10.14456 / ITJEMAST.2019.131

2. A. I. Shinkevich, S. S. Kudryavtseva, G. G. Ivanov, O. N. Korotun, I. I. Ishmuradova, R. R. Gainullina, S. Sh. Ostanina, *Research and Technological Capacity of Russia as an Indicator of Knowledge Economy Growth*, Int. J. of Advanced Biotechnology and Research, **8**, 156-163 (2017)

3. G.A. Beznosov, N.V. Ziablitskaia, L.A. Novopashin, L.V. Denyozhko, A.A. Sadov, N.K. Pryadilina, *Optimization of productive costs on the basis of the marginal utility*, Int. Transaction J. of Engineering, Management, & Applied Sciences & Technologies, **10(5)**, DOI: 10.14456 / ITJEMAST.2019.67

retrieved from: <http://TUENGR.COM/V10/721.pdf>

4. V.I. Trukhachev, S.A. Oleinik, V.Y. Morozov, T.S. Lesnyak, S.P. Sklyarov, *The nutritional value of pasture forage and the assessment of the vegetation index for growing sheep breed Dzhalginsky Merino*, Dusunen Adam, **9(6)**, 1640-1645 (2018)

5. G.R. Garipova, S.S. Kudryavtseva, A.I. Shinkevich, *Features of the management of innovative development of agriculture of the Republic of Tatarstan*, in *Economic aspects of the management of innovative development of the agricultural sector of Russia in regional aspects*, 45-49 (2019)

6. S.B. Ognivtsev, *Digitalization of the economy and the economy of digitalization of the agro-industrial complex*, Int. Agricultural J., **2** (2019) Retrieved from: <https://cyberleninka.ru/article/n/tsifrovizatsiya-ekonomiki-i-ekonomika-tsfrovizatsii-apk>

7. N.A. Safiullin, *Evaluation of the competitiveness of the Kazan State Agrarian University of the Republic of Tatarstan*, In *Contribution of young scientists to agricultural science. Mat. of the Int. sci. and pract. conf.*, 677-678 (2019)

8. N.A. Safiullin, Ch.R. Safiullina, *The use of electronic digital signatures in the agricultural sector*, in *Innovative sci. and educational support for the agro-industrial complex materials of the 69th Int. Sci. and Pract. Conf.*, 384-387 (2018)

9. N.A. Safiullin, Ch.M. Kurakova, *Features of the development of e-government*, in *Development of the agro-industrial complex and rural areas under the conditions of modernization of the economy. Mat. of the I Int. Sci. and Pract. Conf. dedicated to the 90th birthday of Doctor of Economics, Professor N.S. Katkova*, 198-200 (Kazan, 2018)

10. D.I. Fayzrakhmanov, G.R. Valieva, L.N. Savushkina, N.A. Safiullin, *Formation of a model of an innovation and consulting center based on an agricultural university*, Technique and equipment for the village, **4**, 2-5 (2017)

11. *Speeches, theses, reports* (Ministry of Agriculture and Food of the Republic of Tatarstan) Retrieved from: <http://agro.tatarstan.ru/>