# Financing the digitalization of agribusiness: Russian and foreign experience

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**Abstract.** The scientific article is devoted to the study of domestic and foreign experience in financing the digitalization of agribusiness. The purpose of the scientific research is a critical review and analysis of the best domestic and foreign practices for financing the digital reform of the agro-industrial complex and related problems and possible solutions. When preparing a scientific publication, general scientific methods (observation, comparison, measurement, analysis and synthesis, the method of logical reasoning) and specific scientific methods (static analysis, peer review, graphical method) were used. Results: a critical review of domestic and foreign practice showed a significant role of private and corporate investors in the face of venture funds, endowment funds of specialized universities and active processes of intercompany cooperation between agribusinesses and IT companies. In the Russian Federation, the practice of financing the digitalization of the agro-industrial complex, on the contrary, is built on the high centralization of financial resources represented by the state regulator - the Ministry of Agriculture and its subordinate funds. This leads to the conclusion about the need for a deep revision of the mechanism for providing financing in favor of decentralizing tools and popularizing the work of private and corporate funds for financing agrotech, as well as developing the practice of online application through the developing virtual banking service for financing the APK "Smart- Contract".

## 1 Introduction

The relevance of the topic of the scientific article is expressed by the objective impossibility of successfully digitalizing the agro-industrial complex without the sufficiency of finance. Taking into account the peculiarities of the investment cycle in the agro-industrial complex: a long operational cycle of product production, a high dependence on natural and climatic conditions, the importance of qualitative characteristics of biological assets - there are certain difficulties in ensuring sufficient financial support, especially from private investors. A significant negative imprint is placed on the established practice of budget subsidies for agriculture from the state budget, and despite the efforts made to "wash" such a financial stereotype from the management environment, private business remains wary of investing in ag-roteh and agribusiness in general.

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At the same time, the new economic realities require consolidation of the efforts of the private sector and the state to form a new image of the agro-industrial complex sphere, which will be of interest to investors, and whose development will acquire the trajectory of proactive economic and technological development, taking into account the best world practices of inter-company cooperation between the agro-industrial complex and the IT sphere.

Review of the literature on the research topic. The foundation for preparing the theoretical section of a scientific article is publications in foreign periodicals (M. Migliorelli, P. Dessertine [1]; S. Goglio, I. Catturani [2]; E. Gooch, E, F. Gale [3]) and domestic (L.A. Vatutina, E.Yu. Zlobina, E.B. Khomenko; A.S. Obukhova, T.S. Kolmykova, N.P. Kazarenkova, M.K. Chistyakova, M.D. Sayymova, D.A. Zyukin, Z.I. Latysheva, E.V. Skripkina, M.A. Lisitsyn) academic experts involved in the study of domestic and foreign practice of financing the digital reform of the agro-industrial complex. The basis for the preparation of the analytical section of the article is the statistical collections of the National Research University Higher School of Economics ("Indicators of the Digital Economy", "Indicators of Innovative Activity"), analytical reports of the Russian Association of Venture Investors (RVCA), PJSC Rosselkhozbank, the Ministry of Agriculture of the Russian Federation, annual statistical collections of Rosstat "Agriculture in Russia".

The hypothesis of scientific research: its innovative activity and contribution to the state GDP depend on the sufficiency of financial support for the digitalization of the agro-industrial complex. The object of scientific research is the branch of the agro-industrial complex of Russia, the subject of scientific research is the processes of financing the digitalization of agriculture. The purpose of the scientific study is a critical review and analysis of the best domestic and foreign practices in financing the digital reform of the agro-industrial complex and related problems and possible solutions.

From the purpose of the study follows the formulation and solution of the following tasks: 1) a critical review of domestic and foreign models of financing the agro-industrial complex; 2) collection of statistical data on the financing of the digitalization of the agro-industrial complex in the Russian Federation and their analytical processing to form an objective picture of the sufficiency, structure of funding sources and directions for its use; 3) identification of problems and bottlenecks in the organization of financing the digitalization of the agro-industrial complex and the formation of specific, reasoned proposals for their resolution and "unfolding".

## 2 Materials and methods

When preparing the theoretical section of a scientific study devoted to the study of domestic and foreign experience in financing digital reforms in the agro-industrial complex, general scientific methods were used (observation, comparison, measurement, analysis and synthesis, the method of logical reasoning). To conduct a quantitative analysis of the financing of digital reforms in the agro-industrial complex in the Russian Federation, specific scientific methods were used (static analysis, expert assessments, graphical method).

## 3 Results

The sphere of agriculture around the world is one of the most closed industries and is subject to protectionist (including financial interventions from the state) measures of interest, due to its importance in ensuring the food security of the country. This

undoubtedly complicates the task of identifying approaches to organizing the financing of the agro-industrial complex as the starting point for all scientific research. According to the author, in this case, the most correct step is to use the classification used in the framework of the Agreement on Agriculture, approved by the World Trade Organization. So, according to the Agreement, there are three groups of tools for organizing support for the agro-industrial complex:

– "amber basket" – a set of tools for direct and indirect financial support of agribusiness from national state regulators and mainly at the expense of the state budget, targeted state funds, state banks and financial corporations. This block has a pronounced target orientation for the long term and is associated with the financing of fundamental projects for the development of the agro-industrial complex or its restructuring (for example, land reclamation and reclamation, government purchases of finished products, the provision of concessional financing for the modernization and renewal of material -technical base);

- "blue box" - a group of instruments related to private financing of the agro-industrial complex of commercially promising projects related to the expansion or development of new highly profitable activities.This block is dominated by debt (rarely equity) credit and equity investment financing instruments provided by the private sector. Separately, it is necessary to single out the segment of venture financing of innovative projects in the field of agriculture;

- "green box" - a group of tools related to greening and improving the culture of agriculture, aimed at reducing its impact on the natural ecosystem. This block is represented by both the public and private sectors and has a fairly pronounced regionalization and connection with the political interests of the state elite and the level of market maturity of the socio-economic system and its ability to self-regulate.

In the future, this classification will make it possible to form an idea of the position of the agro-industrial complex in the Russian Federation from the point of view of an international regulatory institution. Critical review of scientific literature, in particular scientific publications by L.A. Vatutina, E.Yu. Zlobina, E.B. Khomenko; A.S. Obukhova; YES. Zyukina, Z.I. Latysheva, E.V. Skripkina, Yu.V. Lisitsyn made it possible to establish the existence of another, microeconomic classification of already holistic models for organizing financing for the agro-industrial complex, which will later form the basis for the formation of proposals for improving the financing of digital reforms in agribusiness. The classification is based on the key object for which funding is allocated and the stakeholders associated with this process (Table 1).

**Table 1.** Classification of models for organizing financing of the agro-industrial complex (according to the review of scientific literature).

| Name models | Model characteristic |
|---|---|
| 1. Resource-oriented | Financing of basic business processes, usually associated with the extensive expansion of the activities of an agricultural enterprise. This model is dominated by budget financing instruments and various kinds of tax incentives, customs preferences, etc. In the context of the research topic voiced, such a model can be used in rare cases, usually associated with the crisis state of the used "non-digitized" business model of the agricultural enterprise and only with state support to reach the point of a stable state (i.e., the phase of overcoming the crisis falls entirely on the state regulator and budget sources of financing). |
| 2. Efficiency-oriented | A model focused on the search and attraction of funding for projects related to the reengineering of the existing business model of an agro-enterprise in order to "debottleneck", reduce fixed costs and the impact of the human factor (including in the context of staff shortages among key workers). Funding under such a model may be |

| | |
|---|---|
| | mixed (state subsidies + bank loans), or entirely private. In terms of the criterion of digital maturity, this model involves financing the purchase of infrastructure information and computer systems to improve the efficiency of agribusiness business process management [7]. |
| 3. Innovation-oriented | A higher level model aimed at the organization of comprehensive financing of digitalization of agribusiness for its qualitative transformation and to achieve the level of "digital reality acceptance". As part of this model, inter-firm cooperation with IT companies is a prerequisite, since we are talking about a permanent interaction between the two spheres, respectively, and financing takes more complex forms, such as project and venture financing, and their nature is cyclical, associated with the need to regularly update the architecture of digitized business processes and their updating for new tasks and challenges of internal and external environment. |

At the next stage let's consider the most important features of the organization of financing of digitalization of agriculture in the Russian Federation and the world:

1. In the Russian Federation the financing of the digital transition of the AIC is based on the national program "Digital Economy" (Government Decree № 1632-r of 28.07.2017) and the departmental project "Digital Agriculture", developed by the Ministry of Agriculture, which determines both the national priorities of the digitalization of the AIC, and the funding sources (budget sources - 8000 million rubles, extrabudgetary sources - 1400000 million rubles).

General tools to finance digitalization include financial products of the largest banks with state participation: PJSC Rosselkhozbank (key participant), PJSC Sber, PJSC VTB Bank (investment products), provided on preferential terms: short- and long-term loans, financial agroleasing from JSC "Rosagroleasing", project financing (supplier - Project Finance Factory of VEB.RF). Special tools to finance the digital transition include: the funds of innovative funds (as of 2021, there were 6 specialized venture funds in Russia: Maxfield Capital, Skolkovo Venture Fund - Agrotechnological I, Venture Capital, "TilTech Capital"; Oden Holdings Limited, JSC "Investment and Agrarian Fund") [8].

The general view of the model of organization of financing of digitalization of agro-industrial complex in the Russian Federation is shown in Figure 1: 1) the state represented by regulators informs agribusinesses about the priorities of digital development; 2) agribusinesses form feedback and justify the choice of digitalization directions; 3) the state analyzes the estimate and forms the order to provide funding; 4) after the state regulator approves requests from the agribusiness for funding, agribusinesses apply to the IT sector for project implementation and, if it satisfies (5), they pay for the work done.

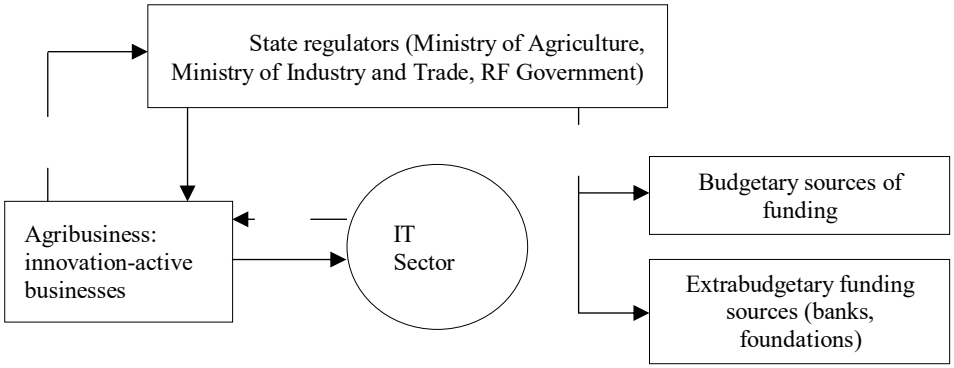

**Fig. 1.** General view of the model of organization of financing of digitalization of the agro-industrial complex in the Russian Federation.

2. In the USA, a country with a much more developed venture and stock market and openness of business to innovations, the financing of digitalization of agriculture is based on the principles of inter-firm cooperation and long-term partnership of agriculture with research institutes and universities and the IT-sphere. The state, represented by sector regulators, has a minor impact mainly in the status of an arbitrator (such a role is played by (National Research Committee; National Institute of Food and Agriculture of the Department of Agriculture) in determining the ownership of development, licensing and certification. A general view of the model for organizing the financing of digitalization of agriculture in the U.S. is shown in Figure 2.

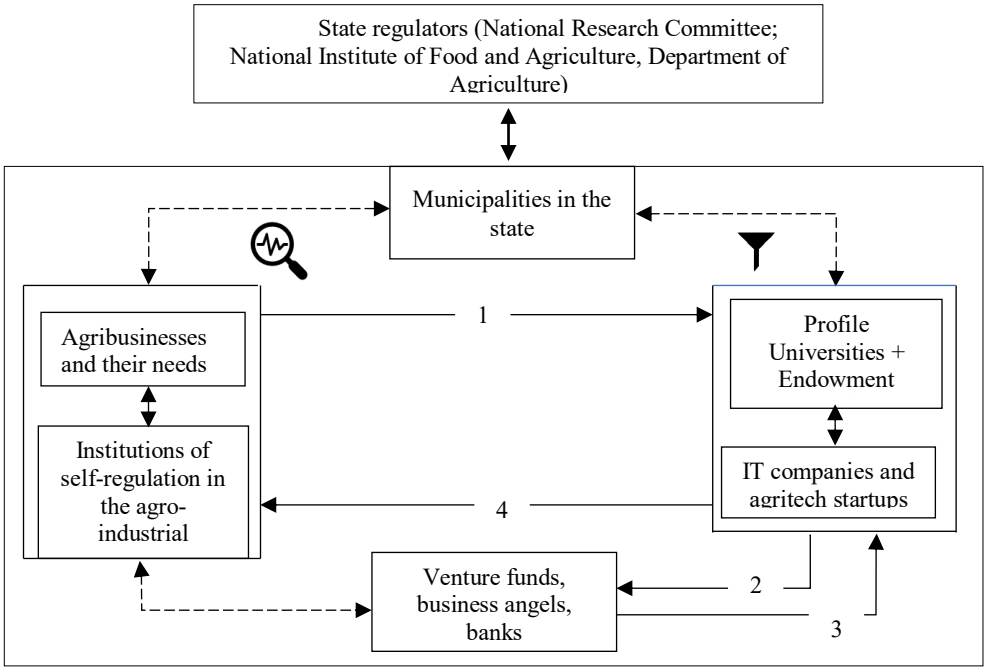


**Fig. 2.** General view of the digitalization funding organization model of agribusiness in the United States. Note: Source: compiled by the author according to [1, 2, 9].

The algorithm for implementing the financing model includes the following steps: 1) businesses in the agricultural sector form a request for digital solutions to the education sector and IT-companies (including startup teams); 2) potential executors form a request for the organization of financing to agents of the financial market; 3) executors receive approval / rejection to provide financing; 4) informing the customer about the decision to participate / reject the development of a digital product. Dotted lines indicate non-permanent (situational) relationships that can potentially arise between participants in the agritech market.

The peculiarity of support of digitalization of agro-industrial complex is a pronounced product specialization of digital solutions among IT-companies and a map of digital priorities, made by the association of farmers in each state, which increases the efficiency of agrotechno-initiatives and profitability of the financing. The peculiarity of financial component is insignificant share of state budget (according to data for 2020 - not more than 20.0%) with active participation of venture capital funds and special credit programs (65-

70% of all financing) [9]. According to the data for 2021 in the U.S. there are 7 largest funds in the world in the field of financing agro-tech start-ups and 4 largest specialized companies to bring business to IPO (publicly traded shares).

In addition, there are endowment funds for the financing of research and innovation projects on the basis of specialized universities engaged in the training of personnel for the agro-industrial complex (the formation of the funds takes place at the expense of the contributions of farmers, state grants and royalties from the commercial use of previously created objects of intellectual property) [10].

In the European Union the organization of the financing of digitalization is based on supranational framework programs, which oversee the main socio-economic trends, declared by the highest political institutions: the European Parliament and the European Commission. The EU has an extended until 2030 paradigm "Reduce costs, but produce more" coupled with the initiative of building a green economy, known as the "Green Deal". [11]. Within the framework of these decisions the following priorities of financing of digitalization of agro-industrial complex are defined: development of non-waste production, transfer of agro-businesses on local fuels, development of breeding and genetics, compensating measures of reducing the impact of agriculture on the environment. Active participants are the IT-sector, the subjects of innovation infrastructure (technology parks), specialized universities, as well as banks, which initiated the special financial programs to support the agrotech. The general view of the model of organization of financing of digitalization of agro-industrial complex in the EU is shown in Figure 3.

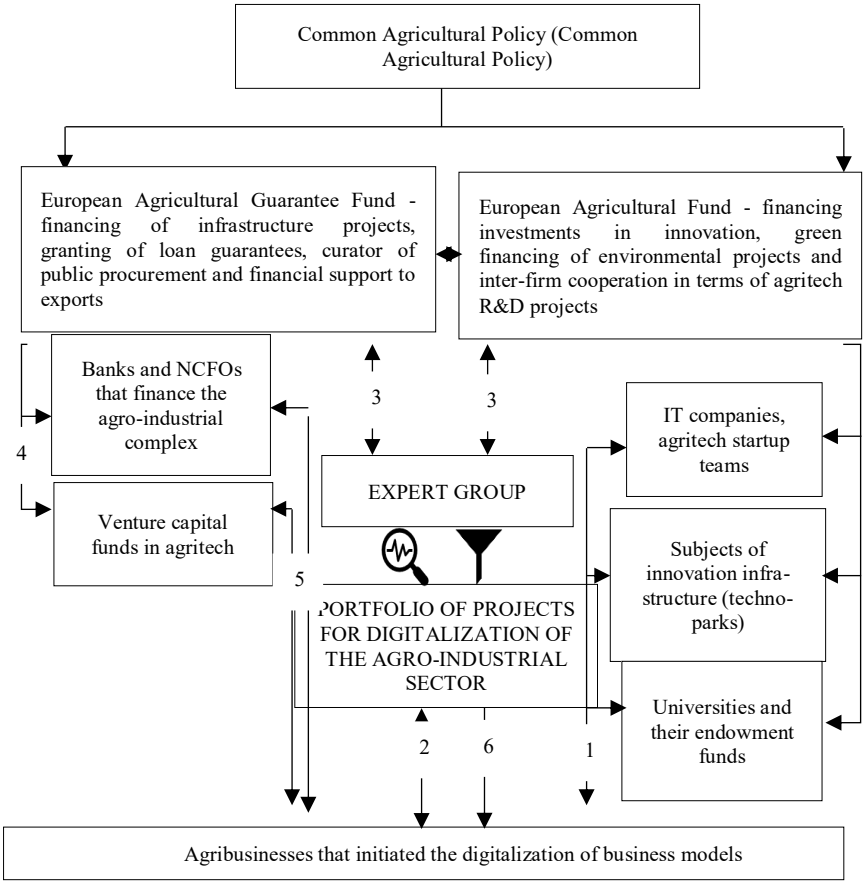

**Fig. 3.** General view of the model for organizing the financing of digitalization of the agro-industrial complex in the EU. Note: Source: compiled by the author according to [2, 11, 12].

The model operation algorithm includes the following steps: 1) a group of digital product and solution generators generates project proposals based on the existing inter-company cooperation between universities and business circles (IT companies, startups) and presents them to agribusinesses; 2) interested agribusinesses form individual portfolios of agro-industrial complex digitalization projects and submit them for consideration to an expert group consisting of representatives of the financial sector, sectoral state regulators, non-profit civil organizations (for example, in the field of ecology, public quality control, etc.) ; 3) the projects selected by the experts are submitted for approval, depending on the target affiliation, for the final examination and approval to the European Agricultural Guarantee Fund or the European Agricultural Fund; 4) project applications approved by the state regulator (business plans for investment projects) are transferred to financial market agents to form a financing scheme; 5) possible schemes for financing projects for the digitalization of the agro-industrial complex are transferred to applicants to agree on the conditions for its implementation; 6) if the financing scheme is approved, the applicant proceeds to the practical implementation of the project.

In the case of the EU, the interest in participating in the financing of projects for the digitalization of the agro-industrial complex is due not only to economic interest, but also to political ones: businesses participating in programs for innovative development and the formation of a green economy receive “bonuses” in ESG ratings from government regulators, as well as new levers of market influence on the financial market as a whole.

At the end of the analytical part of the publication, we will consider the dynamics of financing the digitalization of the agro-industrial complex in Russia for 2017-2021. and structural composition of investment objects (Figure 4).

As follows from the above graph, the main focus in financing the digitalization of the agro-industrial complex is on the acquisition of the latest models of machinery and equipment to increase the productivity of business processes, which is not an unambiguous conclusion about a large-scale digital reform, on the contrary, we are talking about updating the material and technical base and bringing it (if possible) to the level of the leading countries; secondly, this indicates the low maturity of the agro-industrial complex digitalization financing market and the unwillingness of banks to accept the risks of implementing agrotech projects related to the development and implementation of new technologies and digital products that are exclusively intangible due to the complexity of assessing their collateral value and possible resale if the project fails.

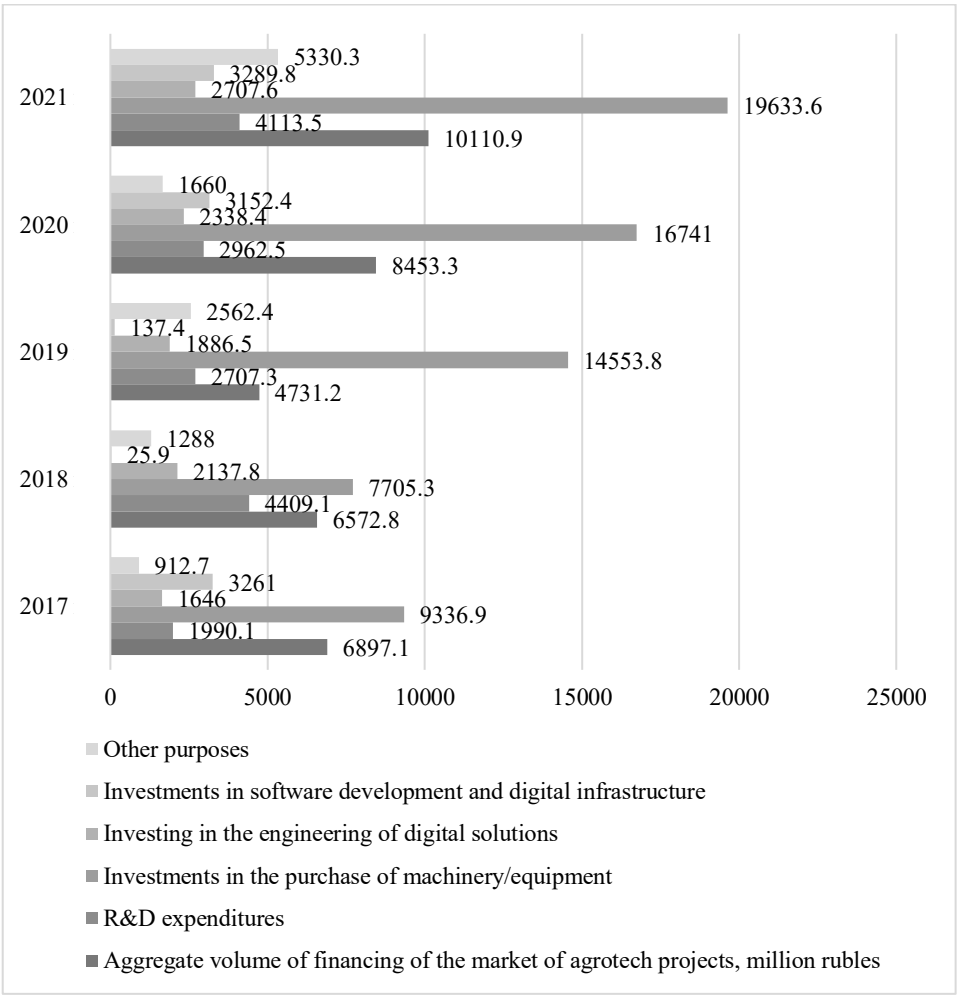


**Fig. 4.** Dynamics of funding for the digitalization of the agro-industrial complex in Russia for 2017 - 2021 and structural composition of investment objects.

In confirmation of the above, the author drew a diagram reflecting the structure of the sources of funding for the digitalization of the agroindustrial complex (Figure 5).

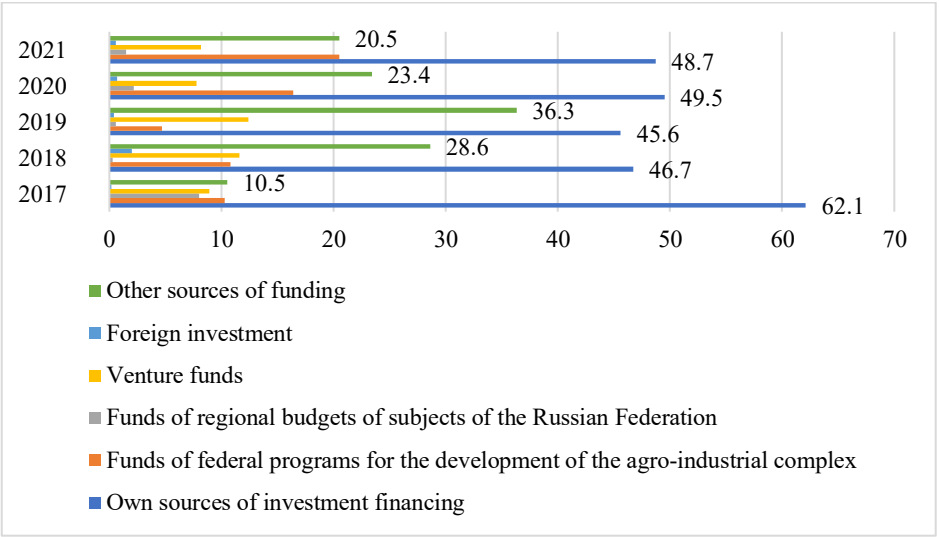


**Fig. 5.** Dynamics and structure of sources of financing of digitalization of agriculture in the Russian Federation in 2017 - 2021, as % of the total.

As follows from the diagram above, we can conclude that the role of own sources of financing is high (on average - 50.5%), which, given the rather high level of unprofitability of operating activities in the agro-industrial complex (according to data for 2020 - 26.4% ), testifies to the concentration of digital initiatives in the group of the largest and most profitable agribusinesses, which de facto form a "circle of the elite" and establish criteria for evaluating the effectiveness of such projects and the general attitude of creditors to allocate funding for the digitalization of the agro-industrial complex.

The second financing instrument with the largest share is financing within the framework of federal programs for the development of the agro-industrial complex, which brings an important touch to the current model of organizing the financing of digital reforms with a significant role of state regulators. At the same time, the share of a purely market instrument for financing innovations - venture funds - averaged 9.8%, although in relation to the Russian Federation, the dominance of the public sector should also be noted here: according to data for 2021, the share of venture funds with state capital amounted to 55.6% (for comparison: private funds amounted to 28.3%, corporate - 30.4%).

Based on the analytical materials presented above, the author identified the key problematic issues of financing the digitalization of the agro-industrial complex in the Russian Federation and possible ways and means of resolving or leveling them (Table 2).

**Table 2.** Key problematic issues of financing the digitalization of the agro-industrial complex in the Russian Federation and possible ways and means of resolving or leveling them.

| Problematic issues | Ways, methods of resolution /leveling |
|---|---|
| 1. Significant prevalence of state funding, which is allocated mainly to large agricultural holdings with a state share and according to priorities determined by the state regulator | 1. Deep revision of the mechanism for providing financing in favor of decentralizing tools and popularizing the work of private and corporate funds for financing agrotech, incl. creation of endowment funds on the basis of specialized state agrarian and technological universities, which will allow, on the one hand, to ensure control over budgetary funds, and, on the other hand, to stimulate innovative activity among the academic community |
| 2. Bureaucratization of processes for | 2. Development of the practice of online filing of an |

| | |
|---|---|
| obtaining funding for SMEs in the agro-industrial complex: currently, a package of documents of 25 items is required, its consideration takes more than 30 days, and there is often a conflict of interest in terms of digitalization priorities between the applicant and the grantor | application through the developing virtual banking service for financing the AIC "Smart Contract" for comprehensive servicing of small and medium-sized farms by providing comprehensive banking and insurance products, incl. grants from innovation funds (subsidies + insurance; soft loans + financial leasing) [13; 14] |
| 3. Geographical imbalance in the distribution of financing for the digitalization of the agro-industrial complex: there is a high concentration in the Krasnodar Territory, Novosibirsk Region, Bashkiria, Voronezh, Tambov, Chelyabinsk, Nizhny Novgorod, Belgorod Regions, while in other regions projects are not approved for financing due to higher risks | 3. It is recommended to use more actively the Unified Federal Information System on Agricultural Lands, launched in 2018, to form a map of areas of potential development of the digital agro-industrial complex, for example, in the field of greenhouse business, animal husbandry, cultural reproduction of wild plants (for example, blueberries, cranberries, mushrooms). ), which will determine both the need for funding and the overall feasibility of allocating funds for the project. |
| 4. The underdevelopment of the direction of green finance and related evaluation metrics and capital provision tools (for example, green bonds, special green loan programs): currently in the Russian Federation, green investments in the agro-industrial complex are 1.6 - 2.3% (depending on type of activity), which does not allow us to consider the adopted program "Green Course of Russia" as a full-fledged stimulating tool for the responsible conduct of agribusiness. | 4. It is recommended from the side of the Central Bank of the Russian Federation and sectoral SROs to make a proposal on the implementation of pilot projects to involve a wide range of stakeholders in green financing, in which all employees can take part, and in the future, the general public, for example, residents of the area where agribusiness is located. The management of such an open investment fund should be transferred to professional market participants, for example, banks that service business, which will make it possible to reinvest capital within the region and ensure its financial stability [3].<br>It is recommended that the following materials be taken as the basis for developing a mechanism for green OIFs: Action Plan for Financing Sustainable Development; proceedings of the European Commission's Technical Expert Group on Sustainable Finance; OECD Working Papers on the Environment. |

**Note:** Source: compiled by the author according to [3, 13–15].

## 4 Discussion

Based on a critical review of foreign experience in organizing financing for the digitalization of the agro-industrial complex, it was found that in the Russian Federation there are currently a number of problematic aspects, the resolution of which is required immediately. The hypothesis about the impact of financing on the innovation activity of the agro-industrial complex can be confirmed by the following higher rates of investment in agricultural technology in the EU and the USA and, as a result, higher rates of innovation activity and contribution to the GDP of these states: for example, in the USA, the intensity of spending on innovation activity amounted to analyzed period 29.0 - 37.6%, while innovative activity was 18.5 - 24.1%, and the contribution of the agro-industrial complex to GDP - 15.7 - 18.3%. In the EU, the intensity of spending on innovation activity is 18.7 - 23.6%, with innovation activity being 19.9 - 22.4%, and the contribution to GDP - 14.8 - 21.5%.

The results of scientific research are rather severely limited by the insufficient development and availability of up-to-date information on the volume of financing of agrotech projects and the structure of participants in such projects, which is associated, on the one hand, with a small number of requests from academic research, on the other hand, with the neutrality of the state regulator and the disinterest of the participants initiate disclosure of information.

The results of a scientific study of the digitalization of the agro-industrial complex will be of interest and useful to regulatory and financial institutions, as well as the leadership of agribusinesses for more efficient implementation of projects for the digitalization of business models. It is recommended to continue the further development of scientific research in terms of developing reporting forms containing more detailed information on financing the digitalization of the agro-industrial complex and giving it a public status.

## 5 Conclusion

A critical review of domestic and foreign practice showed a significant role of private and corporate investors in the face of venture funds, endowment funds of specialized universities and active processes of intercompany cooperation between agribusinesses and IT companies. At the same time, the role of state regulators is mainly reduced to arbitration and control over the compliance of projects with national goals and sustainable development programs (this practice is especially noticeable in the EU). In the Russian Federation, the practice of financing the digitalization of the agro-industrial complex, on the contrary, is built on the high centralization of financial resources represented by the state regulator - the Ministry of Agriculture and its subordinate funds. The same situation is observed in venture financing: according to data for 2021, the share of venture funds with state capital was 55.6%, private - no more than 28.0%.

The urgent solutions to the current practice of "state monopolization" of agro-industrial complex financing should include: a deep review of the mechanism for providing financing in favor of decentralizing tools and popularizing the work of private and corporate funds for financing agricultural technology; development of the practice of online filing of an application through the developing virtual banking service for financing APK "Smart Contract"; activation of the use of the Unified Federal Information System on Agricultural Land for the formation of a map of areas of potential development of the digital agro-industrial complex; implementation of pilot projects to involve a wide range of stakeholders in green financing, in which all employees can take part, and in the future, the general public, for example, residents of the area where agribusiness is located in the form of ESG financing open-end funds.

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