Trends in the development and financing of investment and innovation activities in the agricultural sector of the economy

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Abstract: The purpose of the study is to develop and improve the tools for enhancing investment and innovation processes in the regional agrarian industrial complex under the influence of modern economic threats. Confirmation of the hypothesis about the interdependence of innovation processes in the agricultural economy and changes in the external environment of the industry's functioning is reflected in the generated provisions of the theory and practice of investment and innovative development of the agro-industrial complex sectors, the use of instruments of state regulation of financing of investment, and innovation flows. Using the methodology of systems analysis, a study of innovation and investment processes in the agricultural economy was carried out, considering the manifestation of trends in the digitalization of the industry. Structural deformations and imbalances in investment and innovation processes in the agricultural sector of the economy are revealed. With the use of statistical and economic-mathematical methods, a forecast for the development of agricultural production is proposed, the factors for enhancing the development of the agricultural industry, and the levers of state regulation of innovative processes are substantiated.

Keywords: investments; innovation; financing; economic environment; investment climate; digitalization of agroeconomics

1. Introduction
The modern development of the agricultural industry is largely due to the intensification of investment processes. The identified crisis trends in the global economy make it especially relevant to use investment tools with state support for the dynamic development of the agricultural sector of the economy. At the same time, there is a tendency to reduce the budgetary financing of the industry. The high level of competition in the domestic and foreign agricultural markets requires regulation of investment processes based on improving lending mechanisms with government support and directing investment flows to the development of digitalization of the agricultural economy. In this regard, the problems of this study can be considered relevant and timely. It is determined by the need to solve several fundamental socio-economic problems:
analysis of the state and development trends of the Russian agro-industrial complex, investment activity in the agricultural sector of the economy, and the activity of banks in investment lending.

- justification for the priority areas of investment crediting of agricultural producers with the state support.

- determination of modern directions for the development of informatization and digitalization of the agrarian economy.

In general, the genesis of the problem under study is determined by the constant development of the process of enhancing innovation and investment activities in the agricultural sector of the economy in the context of changes in the external environment, which makes it necessary to develop an appropriate concept and an adaptation mechanism for its timely correction.

2. Methods
The research methodology is based on defining the goal and subject of the research, substantiating theoretical aspects, provisions, approaches and guidelines, arguing the close relationship and interdependence of the development of innovative and investment processes in agriculture and changes in the external environment of the functioning of agricultural organizations. The following general scientific methods and private methodological means of economic development were used as tools of methodology in the article: system approach, systemic and structural analysis, general scientific methods of analysis, synthesis, induction, deduction, generalization, graphic, comparison, statistical observation method, forecasting methods and others.

3. Results

3.1. A systematic approach to improving and updating the concept of innovative and investment development of the agro-industrial complex

Not only the problems of identifying new directions of innovative development, but also the search for sources of attracting investments and mobilizing available investment resources to revive innovation are relevant for the formation of a competitive agricultural system, functioning in conditions of direct dependence on natural and climatic conditions, seasonality, and characteristics of the technological process. The solution of these problems is possible only under the condition of close interaction of investment and innovation processes in agriculture, which entails the need to consider investments and innovations in organic unity and complementarity.

A review of the current state of the problem of innovative development of agriculture revealed that in the process of the genesis and evolution of scientific knowledge a significant set of studies has been formed on many aspects of the functioning and development of the agricultural sector of the economy, including those which has been formed on an innovative basis.

The issues of ensuring innovation and investment development are reflected in the works of Russian and foreign scientists B. Santo [5], B. Twiss [7], A.S. Troshina, I.S. Sandu [8], V.I. Nechaeva [2], L.V. Ty [9] et al.

The economic essence of innovation and its role in increasing the efficiency of agricultural production are highlighted in the works of E. S. Ogloblin, I. S. Sandu, I.G. Ushacheva, I.T. Trubilina [10], P.F. Paramonova [3], A.A. Shutkova [11] et al. Their works develop the theory and methodology of innovation processes in the branches of the agro-industrial complex.

Modern Russian scientists N.A. Borkhunov, A.V. Zaruk [1], V.A. Svobodin [6] and others, as well as foreign agricultural economists I. Perlaki [4], R. Henderson, K. Clark [12] and others dedicated their monographic works to study of economic regulation and stimulation of investment and innovation processes. Despite the fundamental and multifaceted study of the issues of innovation and investment support of the agro-industrial complex and the sufficient elaboration of this problem, we consider it expedient to propose several provisions in the development of the concept of investment and innovation activity in the agricultural sector of the economy.
— synchronization of the mechanism of innovative development of agriculture with socio-economic, natural, and climatic, scientific, and technical, biological, epidemiological, and other transformations.
— implementation of the innovation strategy of the agro-industrial complex entities together with the changes in the methodological and applied aspects of agricultural risk management.
— dynamic adaptation of regional innovation policy to the impact of macroeconomic and social disturbances from outside.
— improving program-targeted regulation in the agro-industrial complex at the regional level and expanding the practical use of new forms and methods of financing investment and innovation activities.
— development of economic and mathematical models of innovative development of agricultural enterprises, ensuring a high level of their efficiency, competitiveness, and resistance to external challenges.

3.2. Research of the state and development trends of the Russian agro-industrial complex, investment activity in the agricultural sector of the economy and the activity of banks in investment lending

The development of the agrarian sector of the Russian economy over a four-year period (2015-2018) is dynamic and undergoes significant changes associated, first, with subsidies for agricultural organizations, as well as changes in the agri-food market (Table 1).

| Table 1. Key economic performance indicators of agricultural organizations |
|-----------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Indicators                                      | 2015            | 2016            | 2017            | 2018            | 2018 to 2015.    |
|                                               |                 |                 |                 |                 |                  |
|                                               |                 |                 |                 |                 |                  |
| Number of organizations, units.                | 20254           | 19595           | 18178           | 17518           | 86,5 -660        |
| Share in the total number of organizations, % |                 |                 |                 |                 |                  |
| profitable                                     | 84,8            | 84,9            | 82,7            | 83,0            | × 0,3            |
| unprofitable                                   | 15,2            | 15,1            | 17,3            | 17,0            | × -0,3           |
| Subsidies from budgets of all levels, million rubles | 163115         | 155338          | 152144          | 155077          | 95,1 -8038       |
| Revenue from the sale of goods, products, works, services in current prices, billion rubles | 2346,4          | 2549,2          | 2591,8          | 2887,9          | 123,1 541,5      |
| Costs of production and sale of goods, products, works and services, billion rubles | 1914,5          | 2169,8          | 2271,3          | 2503,8          | 130,8 589,3      |
| Profit before tax, million rubles              |                 |                 |                 |                 |                  |
| with subsidies                                 | 388852          | 356512          | 272867          | 313337          | 80,6 -75515      |
| without subsidies                              | 225737          | 201174          | 120723          | 158260          | 70,1 -67477      |
| The level of profitability of all activities, %|                 |                 |                 |                 |                  |
| with subsidies                                 | 20,3            | 16,4            | 12,0            | 12,5            | × -7,8           |
| without subsidies                              | 11,8            | 9,3             | 5,3             | 6,3             | × -5,5           |

The number of agricultural organizations decreased by 13.5%; at the same time, it should be noted that profits declined, both with and without subsidies, by 19.4 and 29.9%, respectively.

The volume of subsidies decreased over the period by 5%, therefore, profits decreased at a faster pace, which indicates the influence of a set of factors on the effectiveness of agricultural production. Nevertheless, the significance of state support is evidenced by the fact that the level of profitability without subsidies has halved in comparison with the level of this indicator, which considers subsidies. A similar situation is observed with the change in the levels of profit before tax.

Based on the statistical analysis carried out during the study and the identified mathematical trend, we built a forecast for the development of agricultural production for the short term (Table 2).
As a result of the forecast assessment, it was revealed that if the existing trends persist, the levels of performance indicators may decrease; therefore, it is necessary to develop an adaptive mechanism for synchronous regulation of production, innovation, and investment processes in the agricultural economy, ensuring the efficiency of production and the competitiveness of the produced agricultural raw materials and food.

Table 2. Forecast assessment of the main indicators of development agricultural production in the Russian Federation for a short-term period

| Indicators                              | 2018     | 2019 (estimate) | 2020 (estimate) |
|-----------------------------------------|----------|-----------------|-----------------|
| Rural population, million people        | 37,66    | 37,41           | 37,22           |
| Gross domestic product in agriculture, billion rubles. | 2883,4   | 2878,3          | 2873,2          |
| Arable land, thousands ha.              | 116959   | 117060          | 117162          |
| Gross harvest, million tons             |          |                 |                 |
| wheat                                   | 22,4     | 21,4            | 20,4            |
| corn                                    | 11,5     | 10,9            | 10,4            |
| sugar beet                              | 42,1     | 43,2            | 44,2            |
| potato                                  | 72,3     | 75,8            | 79,3            |
| Milk production, million tons           | 30,6     | 30,8            | 31,0            |
| Wet weight meat produced, million tons  | 14,9     | 15,4            | 15,9            |
| Share of profitable organizations, %    | 83       | 82,0            | 81,2            |
| Profitability level with subsidies, %   | 12,5     | 8,6             | 5,8             |
| Profitability level without subsidies, %| 6,3      | 4,0             | 1,5             |

Analysis of investment flows in the agrarian sector revealed a rather low level of the share of investments in capital funds and attracting foreign capital in investments in the agro-industrial complex. Table 3 shows the distribution of investments in fixed assets of the agricultural sector of the economy by directions.

Table 3. Distribution of investments in fixed assets of the agricultural sector

| Indicator                              | 2015     | 2016     | 2017     | 2018     | 2018 to 2015 |
|----------------------------------------|----------|----------|----------|----------|--------------|
| Premises for cattle, thousand stalls   | 102,6    | 120,7    | 275,1    | 145,4    | 141,7        |
| Premises for pigs, thousand stalls    | 877,3    | 775,7    | 1335,2   | 567,9    | 64,7         |
| Premises for sheep, thousand stalls   | 9,8      | 14,2     | 19,2     | 46,3     | in 4.72 times|
| Premises for poultry thousand poultry places | 5500,9  | 9138,8   | 4979,0   | 3933,5   | 71,5         |
| Granaries, thousand. tons             | 837,7    | 687,0    | 556,8    | 733,6    | 87,6         |
| Vegetable and potato storage, thousand tons | 213,7    | 138,5    | 341,6    | 180,9    | 84,7         |
| Silos for grain storage, thousand tons| 5,0      | 10,3     | 14,5     | 10,9     | in 2,18 times|

As can be seen from the above data, the largest number of livestock places in animal husbandry was created in 2017, already in the next year, 2018, there was a significant decrease in this indicator for cattle, for the pig and sheep breeding industry, the growth trend continued in 2018. The number of poultry houses has been declining since 2016, which is the highest.

Regarding storage facilities, during the study period, investments in the development of grain storage facilities and vegetable and potato storage facilities have a downward trend, which compared to the base
year 2015 amounted to 12.4 and 15.3%, respectively. Investments in the construction and modernization of hay storage facilities have more than doubled.

The material and technical base of agricultural production still needs to be re-equipped with new generation machines. In 2018, there was a decrease in the availability of agricultural machinery compared to 2015 for all types, in particular, for tractors - by 10%; for grain harvesters - by 7.4%; forage harvesters - by 16.8%, which confirms the need to intensify investment processes to carry out technical and technological modernization of agricultural production. Innovative development is possible only on an investment basis. Table 4 presents data on financial investments in agriculture in the Russian Federation for 2017-2018.

Financial investments in the agricultural sector slightly increased over two years and amounted to 1,364.3 billion rubles in 2018, however, in general, the industry's share in the total volume of financial investments in the economy is insignificant and amounts to only 0.55%, which, of course, indicates about the rather low investment attractiveness of the industry.

The overwhelming share, almost 90%, of financial investments is short-term in nature, the remaining 10% are long-term investments.

Table 4. Financial investments in agriculture, billion rubles

| Indicators                                      | Total     | Including     | long-term | short-term |
|------------------------------------------------|-----------|---------------|-----------|------------|
| Financial investments in the economy - total   | 165669,2  | 2             | 246503,4  | 18586,5    | 32636,1    | 147082,7  | 213867,3  |
| of them: to the industry „Agriculture, forestry, hunting, fishing and fish farming“ | 944,8     | 1364,3        | 111,3     | 140,1      | 833,5      | 1224,2    |
| Industry share, %                              | 0,57      | 0,55          | 0,60      | 0,43       | 0,57       | 0,57      |
| Investment structure by term, %                | 100       | 100           | 11,2      | 13,2       | 88,8       | 86,8      |

Regarding the volume of financial investments in the industry, it should be noted that short-term financial investments grew by 46.9%.

A decisive role in the investment development of the agro-industrial complex is played by state support for investment projects in the form of:
- reimbursement of part of the direct costs incurred for the creation and modernization of agricultural facilities, as well as the purchase of machinery and equipment.
- reimbursement of part of the cost of paying interest on loans from Russian credit institutions and loans to agricultural credit consumer cooperatives.

3.3. Justification of priority areas of investment lending to agricultural producers with state support

Increasing the volume of investment lending contributes to technological renewal, innovative development, and an increase in the competitiveness of the industry.

Investigating innovation and investment processes with government support in the industry, we systematized the factors that hinder their development and formed several directions for their improvement.

1. The distribution of state support funds is highly uneven both in the regional aspect and in the context of economic entities - direct recipients of funds. Besides, the predominant share of subsidies is directed not for investment, but for concessional short-term lending. So, in 2019, over two thirds, or 71.8%, of subsidies were approved for loans provided for a period of up to 1 year, and only 28.2% for investment loans provided for a period of more than 2 years.

2. The next problem of investment lending with state support is the high concentration of state support funds for individual lending entities (Table 5).
The presented groupings of the calculation by concentration ratios and the Herfindahl-Hirschman index show, respectively, the level of the share of subsidies received by the three or ten largest market participants, and the value of the index in the context of all regions.

Table 5. Calculation of the level of concentration of subsidies for investment loans

| Share of subsidies chosen by the ten largest market participants | Number of districts |
|---------------------------------------------------------------|--------------------|
| Share, %                                                      | less than 30 | 30-60 | more than 60 | no subsidies |
| Number of districts                                           | 0            | 68    | 8            | 8            |

| Number of districts                                           | 9            | 22    | 46           | 6            |
| Share of subsidies chosen by the three largest market participants |               |       |              |              |
| Number of districts                                           | 32           | 45    | 8            |              |

| Herfindahl-Hirschman index                                    | less than 1800 | more than 1800 | no subsidies |
|---------------------------------------------------------------|-----------------|-----------------|--------------|
| Number of districts                                           | 32              | 45              | 8            |

The three largest players in the form of investment lending receive more than 60% of all allocated funds in 46 regions, while 68% of subsidies are concentrated in 10 regions out of 88. The value of the Herfindahl-Hirschman coefficient also confirms the highly concentrated level of subsidies for investment loans: in 45 regions the indicator accepts a value greater than 1800.

3. Since 2020, it has been planned to divide subsidies into support and development funds, meaning for compensatory (for operational purposes) and incentive (for strategic purposes) components. In essence, this means targeted support for individual regional projects and is distinguished by rationality, since funds are directed to ensuring what is really needed. At the initial stage of the implementation of the measure, it is planned to establish the ratio of the compensating and stimulating parts of the subsidy at the level of fifty to fifty, in the future - thirty to seventy. However, the high efficiency of these innovations is ensured only by the presence of a balanced development strategy for the agrarian sectors of individual regions, otherwise there will be neither adequate ways to determine needs, nor a starting point for experts.

4. Implementation of investment lending programs, for example, by the Ministry of Industry and Trade, has proven its effectiveness as a tool for the development of production cooperative chains, which makes it possible to reimburse part of the capital costs for the construction of new production facilities. There are currently no such programs for the agro-industrial complex, except for agricultural machinery, while they could be actively used for the innovative development of agro-industrial clusters.

5. It is advisable to intensify and expand the widespread use of investment loans with state support to reimburse part of the costs incurred when putting fallow lands into agricultural circulation. The implementation of this measure should contribute to an increase in soil fertility, including through chemical reclamation.

6. The development of such a relevant direction as organic farming requires serious expenditures on the formation of resource potential and therefore needs investment support with the participation of the state.

3.4. Informatization and digitalization of the agricultural economy as a factor in its innovative development

The agro-industrial complex is characterized by the presence of close intersectoral relationships and interactions, a specific resource base, the use of information arrays that require regular processing of significant amounts of quantitative data, therefore, digitalization is essential for the innovative development of its industries and increasing the efficiency of the activities of agricultural entities.

Nowadays agribusiness in Russia has reached a certain maturity, as evidenced by the stabilization of the level of investment in agriculture and the growth of competition among agricultural producers. At the same time, the population is growing, and this trend is typical not only for Russia, but also for the
whole world. In 30 years, humanity will need 1.7 times more food than it produces now, which also confirms the need for digital modernization of the agri-food complex.

As the study showed, it is advisable to define the following as modern directions of development of informatization and digitalization of the agricultural economy.

1. Enhanced use of automated control systems (Hi-Tech Management) in the agro-industrial complex. The lack of information for decision-making leads to the fact that in the process of planting, growing, caring for crops, up to 40% of the crop is lost. Another 40% is lost during harvesting, storage, and transportation. At the same time, as scientists have proven, apart from the weather, two-thirds of the loss factors are controllable.

2. Creation of information technology systems that ensure maximum automation of all stages of the production cycle, which helps to reduce losses, increase business productivity, and optimize resource management. Automated systems of high level of digital integration affect the most complex organizational changes in business. The increase in sensors, sensors and field controllers connected to a single data exchange network increases the level of "intelligence" of the information system, capable of providing the user with maximum useful information.

3. The use of unmanned aerial vehicles in agriculture, performing a variety of useful functions: inventory of agricultural land; creation of electronic maps of fields and cadastral maps; monitoring equipment, the state of crops and fallow fields; support and control of agrotechnical measures, etc. In this regard, special attention should be paid to the formation of a favorable regulatory and legal framework for the operation of drones.

4. Further development and distribution of control systems for unmanned driving (unmanned tractors, unmanned harvesters), as well as development and implementation of navigation and communication elements of onboard and dispatch equipment for control systems for unmanned agricultural equipment.

5. Investment stimulation of the development and implementation of a technological complex known as the Internet of Things (IoT), combining fundamental discoveries in the field of data analysis (Data Science, artificial intelligence, machine learning) and innovative achievements in the development of sensors and self-driving (unmanned) technology.

6. Increased accessibility for farmers, agronomists, consultants of mobile and online applications that combine the results of analyzing data generated by equipment, sensors, drones, satellites, external applications, and field data (coordinates, area, crop type, yield), historical and current factors, including in the external environment, to develop accurate recommendations and a sequence of actions.

7. Investing in the system of training specialists in innovation and digital technologies for agriculture, in particular, in the field of the Internet of Things, operational management of quadcopters, artificial intelligence, Data Science, Big Data, communications.

4. Conclusion

Evaluation of the effectiveness of agricultural organizations has demonstrated the importance of financial support and, first of all, such a tool as subsidizing long-term lending. At the same time, the revealed tendency of reducing the profit indicators of agricultural organizations and the profitability of their activities indicates the presence of problems associated with the influence of environmental factors.

As a result of the forecast assessment, it was revealed that, while maintaining the existing trends, the levels of performance indicators may decrease, therefore, it is necessary to develop an adaptive mechanism for the synchronous regulation of production, innovation, and investment processes in the agricultural economy, ensuring the efficiency of production and the competitiveness of the produced agricultural raw materials and food.

The material and technical base of agricultural production still needs to be re-equipped with new generation machines and technical and technological modernization based on the activation of investment processes. However, in general, the share of the industry in the total volume of financial investments in the economy is insignificant and amounts to only 0.55%, which indicates low investment attractiveness and the impossibility of an early renewal of the material and technical base of agricultural production.
The decisive role in the investment development of the agro-industrial complex is played by state support for investment projects in the form of:

- reimbursement of part of the direct costs incurred for the creation and modernization of agricultural facilities, as well as the purchase of machinery and equipment.
- reimbursement of part of the cost of paying interest on loans from Russian credit institutions and loans to agricultural credit consumer cooperatives.

The study of innovation and investment processes in the industry made it possible to identify the factors that hinder their development:

- uneven distribution of state support funds, the predominance of short-term concessional lending in the total amount of subsidies, a high concentration of state support funds among certain lending entities.
- lack of a balanced strategy for the development of agricultural sectors in individual regions, adequate mechanisms for determining needs and allocating state support funds, investment programs for the innovative development of agro-industrial clusters.
- local, limited only to some regions, the use of investment lending with state support to reimburse part of the costs when putting fallow lands into agricultural circulation.
- insufficient support for the innovative development of the resource potential of organic farming through investment lending.

Priority directions for the development of informatization and digitalization of the agricultural economy have been identified:

- creation of information technology systems that ensure maximum automation of all stages of the production cycle, and activation of the use of automated control systems in the agro-industrial complex.
- the use of unmanned aerial vehicles for various functional purposes, the development and distribution of control systems for unmanned driving, the development and implementation of navigation and communication elements of onboard and dispatch equipment, the formation of a favorable regulatory framework for the operation of unmanned aerial vehicles.
- investment incentives for the development and implementation of the Internet of Things (IoT).
- increasing accessibility for farmers, agronomists, consultants of mobile and online applications that can provide users with the most accurate guidance for action.
- investing in the system of training specialists in innovation and digital technologies for agriculture.

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References
[1] Borkhunov N A and Zaruk A V 2011 The role of innovations in the development of agriculture (Moscow: Agro-industrial complex: economics, management) No. 2 pp 21-25
[2] Nechaev V I et al. 2010 Problems of assessing the effectiveness of innovation and investment projects in crop production (Moscow: Agro-industrial complex: economics, management) No. 12 pp 21-22
[3] Paramonov P F. et al. 2016 Agricultural market of the region: theory and practice (Krasnodar: monograph) p 429
[4] Perlaki I 1980 Innovations in organizations (Moscow: trans. from Slovenian., foreword. by Lapina N I) p 144
[5] Santo B 1990 Innovation as a tool of economic development (trans.. from Hungarian.; under general edit. by Sazonova B V) p 295
[6] Svobodin V A 2013 Methodological issues of determining the effectiveness of the organizational and economic mechanism of agriculture (Moscow: Agro-industrial complex: economics, management) № 2 pp 38-42

[7] Twiss B 1989, Science and Technology Innovation Management (Moscow, trans. from English) p. 271

[8] Troshin A S and Sandu I S Development of the agrarian sector of the economy of the Belgorod region on an investment and innovation basis (Moscow: Economy of agriculture of Russia) № 6 pp 57-62

[9] Tyu L V 2012 Investments as a factor in the innovative development of the agro-industrial complex (Vestnik Novosibirsk State Agrarian University) Т.4 No. 25 pp 130-134

[10] Ushachev, I.G. et al. Innovative activity in the agricultural sector of the Russian economy 636 c

[11] Shutkov, A. A. 2018 Management system of the agro-industrial complex: theory, methodology, practice (Moscow) p 390

[12] Henderson R M and Clark K B 1990 Architectural Innovation: the Reconfiguration of Existing Product Technologies and the Failure of Established Firms (Administrative Science Quarterly) T 35 № 1 pp 9-30