**Model of investment process of complex modernization of machine systems in potato production**

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**Abstract**. The article deals with the problems and certain economic aspects of forming a model of the investment process of complex modernization of the machine system in potato production. The article analyzes the main factors that prevent the widespread introduction of advanced systems of machines for growing potatoes in various regions of Russia. It is proposed to use, along with measures of state support for direct commodity producers, economic instruments to stimulate the creation of agricultural investment partnerships focused primarily on accumulating and investing capital in the acquisition of advanced technologies and machine systems in agriculture, regardless of the financial and economic state of economic entities, including for small and micro commodity producers.

**Keywords:** investment, state support, machine system, agriculture, potato growing.

**Introduction.** Currently, one of the key problems that hinder the development of agro-industrial production in our country is the lack of widespread use of advanced innovative technologies by agricultural organizations, peasant farms and individual entrepreneurs. Despite the envisaged measures of state support for agriculture, implemented since the adoption of the Federal law “On agricultural development” in 2006 and specifically implemented in the adopted relevant programs for the period 2008-2012 [1] and 2013-2020 [2], the updating of the material and technical base of agriculture significantly lags behind the standards recommended by specialists. For example, according to experts’ estimates [3], only 12.6% of potato harvesters were written off due to wear and tear at a rate of 14.3%, which forces agricultural producers to use worn-out equipment, which is also obsolete in the conditions of development and application of innovative, including digital, technologies for growing potatoes. One of the reasons for the lag in updating equipment is the remaining low profitability of potato production and the predominance of the share of households (as of 01.01.2019 – 68% [4] of the 22.4 million tons of crop grown in 2018).

The conceptual directions of the modern policy of state support for the agro-industrial complex provide for a fairly wide range of economic measures and mechanisms aimed at updating the material and technical base of agricultural producers. During the implementation of the State program for the development of agriculture and regulation of the market of agricultural products, raw materials and agricultural products for 2008-2012 and continued for the period 2013-2020, state support measures included: preferential lending; preferential lending to agricultural consumer cooperatives; subsidies to reimburse part of the interest rate on investment loans taken before January 1, 2017; compensatory and incentive subsidies; unrelated support to agricultural producers; compensation for part of the direct costs incurred for the creation and (or) modernization of agricultural facilities; subsidies to producers of agricultural machinery; compensation for part of the cost of transporting agricultural products by land, including rail transport, etc.

The implementation of these measures in the period 2007-2018 allowed stabilizing the level of technical equipment, first of all, of large agricultural producers, reversing the negative processes in the financial and economic situation of the main categories of producers of agricultural raw materials and agricultural products. So, if in the period 2007-2010 there was a decrease in the level of providing tractors per 1000 ha of arable land from 5.1 units to 4.2 units, in the period 2012-2018 this indicator is stable and is equal to 3 units.

During the periods under review, a relatively stable financial and economic situation of agricultural organizations was achieved, including through budget subsidies (table 1).

**Table 1**. The level of profitability for all activities of agricultural organizations in Russia

|  |  |  |
| --- | --- | --- |
| Years | including subsidies, % | without subsidies, % |
| 2007  | 16,7 | 7,9 |
| 2008  | 14,8 | 2,2 |
| 2009  | 9,4 | -3,2 |
| 2010  | 8,3 | -5,4 |
|  |
| 2015  | 20,3 | 11,8 |
| 2016  | 16,4 | 9,3 |
| 2017  | 12 | 5,3 |
| 2018  | 12,5 | 6,3 |

Source: Agroindustrial complex of Russia in 2010 and agroindustrial complex of Russia in 2018. Ministry of Agriculture of Russia.

But, at the same time, it is necessary to take into account that “... within the terms of depreciation there is 47% of tractors… The situation is similar with other agricultural machinery. In the current economic situation, agricultural producers are forced to leave part of the equipment that is subject to write-off in operation. According to Rosstat, only 6.2% of tractors (standard 10...12.5%), ... 6.8% of combine harvesters (standard 10%), 9.5% of forage harvesters (standard 14.3%)”[3].

According to the All-Russian Agricultural Census of 2016, agricultural organizations, peasant farms and individual entrepreneurs had 200.5 thousand units of tractors with a 9-year or higher service life; 59.8 thousand units - within the term of 4-8 years of service; 34.6 thousand units - up to 4 years of service. In the context of agricultural organizations, the share of tractors operated for more than 9 years ranges from 65% (microenterprises) to 70% (small organizations), and in farms it was about 63%.

Analysis of the results of the ARAC-2016 also showed that agricultural organizations (large and small) had only 2,382 units of potato planters and 2,547 potato harvesters as of June 2016. And farms and individual entrepreneurs owned and leased 2,927 potato planters and 2,067 potato harvesters. Or, in all forms of management, 1 potato plant had an average of 59.1 ha of potato sown area, and 1 potato harvester had 72.5 ha of harvesting area. The study also revealed differences in the load on agricultural machinery depending on the size of farms and the form of management. For example, in small agricultural organizations, 185 ha of crops were planted per unit of potato planting in 2016, while in large and medium-sized organizations, 56.5 ha of potato acreage was sown (figure 1).

**Figure 1.** Average load on certain types of agricultural machinery of potato crops in the Russian Federation, ha

The author’s calculation according to ARAC-2016 data

Such a significant predominance of outdated tractors in agriculture as a whole, as well as a small number of specialized agricultural equipment in potato production, requires not only adjustments to the program of technical and technological modernization of agro-industrial production. In our opinion, we need a radical revision of the main directions of investment activity development and the financial and economic mechanism for activating the investment process of production modernization. Especially if we take into account the transition of developed countries’ economies to the use of digital technologies in agriculture, which creates significant competitive advantages for them in the entire reproduction chain: production-transportation-storage-processing-sales.

To ensure technological modernization on an innovative basis, taking into account the increased requirements for equipment for performing agrotechnological works, measures are needed that would encourage the introduction and use of a whole complex of equipment – a system of machines. And, above all, automated and robotic systems of machines, including expanding the use of digital technologies in the production process at the main stages, from pre-sowing tillage to primary post-harvest processing, packaging, transportation, etc. One of these measures that has fallen out of sight of lawmakers is the institutional component of the investment process. In particular, despite the adoption of normative acts regulating the formation and use of various investment institutions, their form of investment partnership has not found its proper application in the agricultural sector of the economy.

**Methods**.

The research used a wide range of analytical methods for studying economic phenomena -monographic, statistical, and others. Special attention was paid to the comparability of indicators for analyzing the dynamics of the studied processes. For the analysis we used data of Rosstat, the Ministry of Agriculture of the Russian Federation, the Central Bank of Russia, Ministry of Finance, Department of Economics of the Interstate Commission of the EEU and others. The results of the All-Russian Agricultural Census-2016 were actively used, as well as materials of research works of industrial scientific institutes.

**Results**. In 2018, potato production in all economic entities of the village amounted to 22.4 million tons, of which agricultural organizations accounted for 19.3%, and peasant farms - 12.7%. According to the Ministry of Agriculture of the Russian Federation, 15.4 million tons or 68% of the total production of potatoes were grown in households. During the years of reformation and establishment of the market economy, the main producers of potatoes were and are still households (both rural and often urban), and not economic entities engaged in business activities. Socio-economic aspects and causes of this phenomenon in the market model of management are the subject of independent in-depth research. Here we note that changing this situation will require not only increasing production of commercial and domestic seed potatoes by agricultural producers, but also significant modernization of technology and introduction of advanced machine systems, including specialized ones.

Meanwhile, achieving a significant increase in potato production to the volume that could replace the share of households (although this goal is not set in the near future) is difficult due to the lack of available financial resources and investment funds necessary to purchase modern machine systems, not to mention updating the entire material and technical base of agricultural producers. Analysis of accounting statements of farms whose main activity potato production was indicated, and according to the data testfirm.ru., among the top twenty producers in terms of revenue and asset value, showed that: 37.4% of households had a return on sales of products in the range of 27% to 34.4% for the period 2011-2018; about 12.5% of households had a return on sales of 12.4-14.6% and 25% of households received no more than 5% of profit per unit of costs; the remaining group had losses.

The EBITDA indicator (equal to the sum of net profit, interest and tax payments, depreciation expenses), which characterizes the ability of a commodity producer to meet its obligations, has a positive value in almost all the farms under consideration (table 2).

**Table 2**. Return on sales of potatoes in a sample of farms, on average for 2011-2018

|  | EBITDA, thousand rubles | Return on sales, % | Return on assets (ROA), % | Return on equity (ROE), % |
| --- | --- | --- | --- | --- |
| Profitable |
| LLC «Harvest» | 9 184 | 34,2 | 39,0 | 33,7 |
| LLC «Vereya» | 2 344 | 32,3 | 28,0 | 16,0 |
| LLC «Potato» | 6 615 | 30,2 | 54,0 | 25,2 |
| LLC «Agroforward» | 6 968 | 29,0 | 4,0 | 3,6 |
| LLC «Radogosh» | 54 891 | 27,9 | 28,1 | 22,6 |
| Unprofitable  |
| LLC «Rakovskoe» | -22 762 | 0,0 | -33,1 | -8,0 |
| JSC «State Farm Zarechnoe» | 32 364 | -7,5 | 7,2 | 6,6 |
| APC «Sokolovsky» | 35 365 | -15,2 | 9,8 | 9,1 |
| APC "Sanyyakhtakhsky» | 3 715 | -31,1 | 8,3 | 4,6 |
| JSC "State Farm Yuzhno-Sakhalinsky»  | 75 571 | -71,1 | 3,2 | 2,5 |

Source: the author’s calculation on the data: [www.testfirm.ru](http://www.testfirm.ru)

However, its volumes remain insufficient for the timely and complete comprehensive modernization of the main technical means for performing narrow operations (combing machine, potato planter, potato harvester, potato sorting, etc.) in the production of potatoes. But they are also insufficient for updating intangible assets, the value of which increases significantly in the transition to the use of automation and robotics systems. For example, in JSC "Rusevroplast" for the period 2012-2018 on average, the dynamics of investment is negative with a relatively small increase in revenue from the sale of potatoes (Table 3).

**Table 3**. Indicators of investment activity of individual producers (on average for 2012-2018)

|  | Revenue per 1 ruble of investment, ruble | Investments per 1 ruble of revenue, ruble | Net profit per unit of investment, ruble | ∆RV | ∆Inv |
| --- | --- | --- | --- | --- | --- |
| JSC AIC "Belorechensky" | 6,17 | 0,17 | 0,52 | 1,032 | 1,234 |
| APC "Pushkinsky" | 10,78 | 0,12 | 0,95 | 1,088 | 1,384 |
| JSC "State Farm Yuzhno-Sakhalinsky" | 3,00 | 0,33 | 0,18 | 1,358 | 1,108 |
| LLC "Rakovskoe" | 2,90 | 0,47 | -0,74 | 1,693 | 0,604 |
| JSC "RusEvroplant" | 36,24 | 0,19 | -11,1 | 1,113 | 0,804 |

Source: the author’s calculation on the data: [www.testfirm.ru](http://www.testfirm.ru)

\*Calculation for 2014-2018

Only one set of agricultural machinery as part of a milling rotary cultivator (the range of prices on average 230 000 – 890 000 rubles), potato planters (40 000 – 198 000 rubles), potato harvester (1100 000– 2 100 000 rubles of various models), potato sorting point (100 000 – 1 900 000 thousands rubles) require investments from 1.5 million rubles to 5.9 million rubles and more. If you add general-purpose equipment, which can include machines for soil cultivation, fertilization and plant protection, vehicles for transportation from fields to sorting stations, etc. [5], the required investment volume increases several times.

**Discussion**

In our opinion, without adjusting the state support for investment processes in terms of capital investment for the formation of a system of machines in agriculture, which is understood as a system of investment institutions, organizational measures and financial and economic instruments for attracting and using long-term capital to provide agricultural producers with advanced innovative complexes of agricultural machinery and agricultural machines based on the use of automated, robotic and digital technological solutions (or technologies), it is problematic to attract the required amount of funds in the capital market in order to perform the necessary agrotechnological operations in a timely manner.

As an integral part of the overall program of technological modernization of agro-industrial production, support for the formation of a system of machines can and should be allocated to a separate sub-program with the development of forms, methods and mechanisms of the investment process.

At the same time, we will briefly focus on the concepts of “investment process” and “investment activity”. According to the Federal Law of the Russian Federation “On investment activities in the Russian Federation carried out in the form of capital investments” dated 25.02.1999 N 39-FZ (ed. from 02.08.2019) investment activity is an investment and implementation of practical actions in order to make a profit and (or) achieve other useful effects [6]. Investment process (the process is defined as the course, development of a phenomenon, a sequential change of states in the development of something [7] or change, development, evolution, etc. [8] in nature or society) in a narrow interpretation , it is a sequence of stages, actions, procedures and operations for the implementation of investment activities, and its specific course is determined by the object of investment and types of investment (real or financial investments). The broad interpretation of the investment process reflects changes in the quantitative and qualitative parameters of the components of the investment movement - the formation, accumulation, distribution and use of capitalized savings. And, accordingly, the model of the investment process is, in our opinion, a single system of investment movement and includes a set of main institutions involved in the movement of capitalized savings in the implementation of the reproduction of fixed assets and their relationship with each other, as well as their regulation at the federal, regional and municipal levels. At the same time, such institutions as investment partnerships, investment funds and financial companies (insurance companies and pension funds) and others are the main elements of the model, which, through economic instruments and government incentive policies, can significantly expand the flow of long-term capital to the agricultural sector of the economy. One of the variants of the model for small businesses can be shown based on the results of the All-Russian Agricultural Census-2016, which revealed that the number of farms growing potatoes for sale in the total number of surveyed is very significant. For example, 46% of the 5273 surveyed peasant farms sell more than 64.4% of the grown potatoes, and only 7% of this form of management sells less than 11% of these products. Approximately the same trend in the distribution of farm groups by the level of sold potatoes is observed in other forms of small business. Therefore, in our opinion, the most reasonable model for effective implementation of the investment process for small and microenterprises, individual entrepreneurs and peasant farms is their participation in an investment partnership, the activities of which are regulated by the Federal Law of the Russian Federation “On investment partnerships” No. 335, which came into force on 01.01.2012. In this law, the investment activity of an investment partnership is defined as the acquisition and (or) alienation of stocks (shares), bonds of business entities, and financial instruments of fixed-term transactions that are not traded on the organized market (clause 1 of article 2 of the Federal law of the Russian Federation No. 335). And, it is the small agricultural business that can be the object of interest from the investment partnership.

The relationship of investment partnerships shown on Figure 2 and created by small and micro agricultural producers reflect: relationship with government - in the form of inclusion in the program of state support from federal and (or) regional (municipal) budget; relationship with the credit agricultural cooperative – a possible connection to the financing of unprofitable farms for entry into the investment partnership (the repayment of principal and interest scheme provided by the credit cooperative’s participation in the income of agricultural producers).

Federal research centers, innovative companies of agricultural profile

State

Manufacturers of agricultural equipment and agricultural machinery

Agricultural credit cooperative

Profitable Unprofitable

Small agricultural organizations, farms and individual entrepreneurs - Managing partners and associates

**Figure 2.** The basic model of the investment process of small agricultural businesses with the participation of the created investment partnership

The relationship with suppliers of means of production and innovative companies is carried out by managing partners in the group of profitable and unprofitable farms, purchasing the necessary agricultural equipment and precision farming technologies for growing potatoes.

Taking into account that legal entities and individual entrepreneurs up to 50 persons can participate in an investment partnership, its creation by small-business agricultural producers, agricultural production and sales cooperatives, individual entrepreneurs and others may be rational within one or several neighboring municipal districts for the acquisition of, for example, precision farming technology [9]. These technologies include such elements as: navigation and telemetry systems (systems for precise positioning of the unit in the field, parallel driving, crop mapping); remote sensing of the ground, for example, rapid acquisition of satellite images and aerial photographs; geoinformation systems (GIS); technologies for differentiated fertilization [10]. In addition, this includes such main areas as the use of robots in agriculture: unmanned vehicles and aircraft; automated systems for growing crops.

Participation in the formation of the resource base of an investment partnership in accordance with the Federal Law of the Russian Federation depends on the status of its partners. The managing partner invests money, other assets, property rights, professional knowledge, skills and knowledge, as well as business reputation. A friend’s contribution is made only in the form of cash. However, in one such partnership, it is allowed to have several managing partners, which allows using different approaches to the mechanism of combining and attracting long-term funds. The first approach involves the formation of an investment partnership with the participation of one managing partnership and up to 50 members. In this case, the funds of the partners in accordance with the law are accumulated in a separate account opened by the managing partner in the amount necessary for the purchase of a complex (or part of it) of highly mechanized agricultural machinery (as automated and robotic equipment becomes available). These funds are then invested in the authorized (stock) capital of one of the partners, who acquires the necessary list of equipment or complex of agricultural machines previously agreed at the general meeting of the investment partnership. The second approach, in which the investment partnership provides for several managing partners, the accumulated funds can be invested in the equity (stock) capital of several participants. The principle of distribution of funds between the participants of the partnership may be determined by a factor of technological or territorial isolation. For example, investments in innovative potato growing technology are made separately from investments in the storage and processing system, transport and logistics link. However, it is common to use the purchased equipment in the interests of all the partners of the investment partnership. As an option, we considered the mechanism of issuing debt instruments by one of the partners and directing the accumulated capital by the investment partnership to purchase bonds. However, given the financial and legal aspects that accompany the organization of the issue and placement of bonds, it was considered more economically justified to apply this tool and mechanism for medium and large, rather than for small agricultural producers.

**Conclusion**

This approach, in our opinion, will help to orient the participants in the investment process – the state, credit institutions and leasing companies, agricultural producers – to implement a program of comprehensive renewal of the material and technical base of agro-industrial production on the basis of technological modernization, not of individual elements, as is mainly implemented in practice at present, but of all elements (blocks) of the machine system in crop production, united in a single reproduction and logistics and wholesale and retail chain of promotion of agricultural products.

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