Mechanism for increasing innovative activity in agriculture in Russia using programming

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Abstract. A model of scientific and technical development has developed. In the agriculture of Russia, which is characterized by a high degree of dependence on foreign technology, techniques and selection achievements. Current national priorities to be determined by the program documents of the country's socio-economic development imply the development and implementation of programs consisting of a set of measures focused on the creation and implementation of competitive domestic technology, seeds, breeding products, feed additives and medicines for animals, pesticides, agrochemicals, and other factors of production in areas with a high degree of import dependence. In this regard, the analysis of the results of the implementation of the Federal Scientific and Technical Program for the Development of Agriculture for 2017-2025 from the standpoint of achieving the goals and objectives set by the state is relevant. The activities of organizations, participants in comprehensive scientific and technical projects are analyzed. The purpose of the work is to assess the adequacy of the measures provided for by the projects to reduce the impact of the main problems that impede the activation of innovative activities.

1. Introduction
World experience shows that the socio-economic development of the state that ensures competitiveness in the foreign market is based on the acquisition and use of new knowledge [1-5].

A model of innovative development has developed in the Russian Federation that is characterized by the predominant use of foreign equipment, technology, selection achievements and other factors of production. In order to eliminate dependence on foreign technologies, the state pursues a policy that stimulates the transition of the economy to such a development model that involves the design and implementation of up-to-date domestic technology and selection achievements, which implies high innovative activity in the industry [6-8].

The current priorities of scientific and technological development of the agribusiness are determined by the Federal Scientific and Technical Program for the Development of Agriculture for 2017-2025 (FSTP), within the framework of which it is planned to implement 14 subprograms solving the problem of ensuring stable growth in agricultural production and increase in competitiveness in terms of reducing dependence on foreign genetic material and related technology. The FSTP contains the main mechanism for the implementation of subprograms in priority areas for the state. These are comprehensive scientific and technical projects (CSTP), that is to say, coordinated integrated systems
of controlled types of work structured according to the FSTP activities. CSTPs are aimed at achieving the planned results to be implemented by the project customer based on the principles of public-private partnership focused on obtaining scientific and / or scientific and technical results (STR) and their transfer for application (implementation) in production and obtaining innovative products on an industrial scale [9].

The mechanism for the implementation of the CSTP looks summarily like this: a Russian scientific organization merges with a commercial organization (CSTP customer), contributes in the form of results of intellectual activity (RIA: new varieties, breeds, hybrids, crosses, etc.), a commercial organization invests its own funds, organizes production, replicates RIA, implements them, recouping its costs and rewarding the contribution of a scientific organization, which together leads to the achievement of the objectives, i.e. to increase the share of Russian varieties (breeds, hybrids, crosses, etc.) on the market. CSTP receives co-investment from the state in the form of a grant, which significantly increases the feasibility of projects, as well as the interest of participants, since it allows them to modernize the material and technical base [9-10].

The implementation of the FSTP provides for the solution of a number of tasks, including the creation of conditions for the development of scientific / scientific and technical activities and obtaining the results necessary for the development of technology, as well as the creation and implementation of technology and the attraction of investments [9]. The main objective of the program is to ensure stable growth in production and improvement of quality of agricultural products based on scientific and technological support for the agribusiness development for the long term, including that in the areas of domestic crop and livestock production, which currently have a high degree of import dependence.

2. Materials and Methods
The subject of the study was the CSTP member organizations, which perform research and development in the field of agriculture and ensure their implementation in production. The purpose of the work is to assess the sufficiency of the measures provided for by the projects to solve the main problems that impede the activation of innovation in the agribusiness, to determine the prospects for the process and justify the positive experience dissemination. The study was based on a general scientific methodology using methods of monographic, comparative, factorial and logical analysis, as well as an expert-analytical method for processing initial information. The information base was statistical information from the Federal State Statistics Service of the Russian Federation, scientific organizations of the Russian Academy of Sciences (RAS) and the Ministry of Agriculture of the Russian Federation. Materials from research institutions, papers of leading domestic and foreign scientists in the field of research, and regulatory and legal acts that establish strategic guidelines for the development of the country and the industry were used.

3. Research Results and Discussion
The efficiency of current agricultural production, its competitiveness and further development significantly depend on the degree of use in production of the latest achievements of science and the innovative activity of agricultural producers. The modern model of technological development provides for the advanced development and upgrading of the Russian economy through the widespread development of basic innovations.

The innovative activity in agriculture was at a low level of 5.4% in 2018. The most innovatively active sector is mixed agriculture (without specialization, in which the share of crop or livestock production is less than 66% in the gross profit structure) with an innovative activity level of 16.3%, and the seedling production sector with an innovative activity level of 14.3% [11]. At the same time, 50% innovative activity level is in the USA [8; 12].

Among the main factors hindering the activation of innovative activity, there are the following ones:
- Weak public-private partnership supported by the process of establishing a material base for creating innovations;
- Long payback period of innovation;
- Insignificant amount of government investment;
- Unformed state regulation of the planning, creation and implementation of innovations, primarily grant support for scientific research, which does not take into account a number of features, including those for agricultural research organizations;
- Lack of demand for innovation [12];
- Lack of free funds from manufacturers to upgrade production and introduce innovations, as well as the unwillingness of enterprises to attract borrowed funds due to high interest rates on loans [8].

The algorithm for the CSTP implementation assumes the coordination of the activities of all participants in innovative activities, including the creation of scientific and technological revolutions, their approbation and implementation, which corresponds to such CSTP activities as “Creation of scientific and / or scientific and technical results and products for the agribusiness”, “Transfer of scientific and / or scientific and technical results and products for practical use and advanced training of participants in scientific and technical support for the development of agriculture”, and “Commercialization of scientific and / or scientific and technical results and products for the agribusiness”. In this regard, the effectiveness of the CSTP envisaged measures is of interest from the standpoint of reducing the influence of factors that impede the activation of innovative activity in the agribusiness on the example of potato growing, which plays an important role in ensuring food security in many countries [13-14]. Potato growing in Russia is characterized by high import dependence in seed material. The domestic potato seeds occupied only 9.7% of the area under potatoes in 2019 [11].

The CSTP subprogram titled ‘Development of potato breeding and seed production in the Russian Federation’ has been implemented since 2018. Already in the first year of implementation, 312.7 metric tons of original seed potatoes and 185,000 mini-tubers were produced, and two new varieties of potatoes were created:

- Gulliver (patent holder is All-Russian Scientific Research Institute of Potato Farming): early table variety, yield is 370 hundredweight / ha, resistant to cancer and *Globodera rostochiensis*, and to potato rugose and streak mosaic;
- Tango (patented by the ‘Kazan Scientific Center of the Russian Academy of Sciences’ Federal Research Center): late ripening table variety, yield is 340 hundredweight / ha, resistant to late blight of tops and tubers, cancer and scab, medium resistant to *Rhizoctonia* blight.

In addition, three processes have been developed and patented that are effective for breeding and seed growing of potatoes: a method of planting seed potatoes and applying organic fertilizers to the holes using a walk-behind tractor and a device for its implementation (patent holder is Federal Scientific Agroengineering Center VIM); a biotechnological installation for the production of potato seed material (patent holder is Tulaykov Samara Scientific Research Institute of Agriculture; a capillary electrolytic method for extracting micro and nanoparticles of metal compounds from fine fractions of rocks, ores and man-made products (patent holder is Volga Federal Research Center of the Ural Branch of the Russian Academy of Sciences). A single license agreement has been concluded for the use of the result of intellectual activity created within the framework of the subprogram (with Malyanov Agrogroup LLC) [15].

The Ministry of Agriculture of Russia allocated grants to CSTP customers 438.7 million rubles under the subprogram in 2019 (table 1) [16].
Table 1. Provision of grants to ‘Development of potato breeding and seed production in the Russian Federation’ CSTP customers in 2019 (‘000 rubles).

| Item | Project customer | Grant amount | Additional funding | Total amount of donated grant funds |
|------|------------------|--------------|--------------------|------------------------------------|
| 1    | SSK Ural potato LLC | 42,354.9     | 6,701.3            | 49,056.1                           |
| 2    | Ozery JSC        | 66,536.2     | 12,000.0           | 78,536.2                           |
| 3    | Elita-potato Greenhouse facilities LLC | 2,916.2 | 0.0 | 2,916.2 |
| 4    | Redkinskaya APK LLC | 4,451.1     | 2,550.0            | 7,001.1                            |
| 5    | Agrolinter LLC   | 10,654.9     | 1,839.2            | 12,494.0                           |
| 6    | Agli Peasant (Farm) Household (PFH) | grant is suspended | grant is suspended | |
| 7    | Agrofirm Promyslennaya LLC | grant is suspended | grant is suspended | |
| 8    | Agrostar LLC     | 4,491.0      | 3,435.5            | 7,926.4                            |
| 9    | Agrofirm Glory to the potato - Yaachi LLC | 9,927.3 | 4,597.2 | 14,524.4 |
| 10   | FAT-AGRO LLC     | 69,697.4     | 18,875.2           | 88,572.6                           |
| 11   | Belorechenskoe Agricultural Public Joint Stock Company | 1,385.2 | 0.0 | 1,385.2 |
| 12   | Kalina PFH       | 2,449.8      | 0.0                | 2,449.8                            |
| 13   | SoyuzAgro LLC    | 0.0          | 0.0                | 0.0                                |
| 14   | Zolotaya Niva LLC | 7,295.9      | 3,295.2            | 10,591.1                           |
| 15   | Agro-industrial company Lyubovskoe LLC | 7,776.6 | 0.0 | 7,776.6 |
| 16   | SHP Dary Malinovki LLC | 24,984.4 | 12,560.9 | 37,545.3 |
| 17   | Kolpakov LLC     | 19,300.4     | 9,414.4            | 28,714.8                           |
| 18   | Zolsky potato LLC | 1,958.5      | 31,170.8           | 33,129.4                           |
| 19   | Pogarskaya potato factory JSC | 1,944.1 | 18,448.0 | 20,392.1 |
| 20   | Nikolsk Agricultural production cooperative | 2,770.4 | 0.0 | 2,770.4 |
| 21   | SeDeK Farm LLC   | 9,526.3      | 0.0                | 9,526.3                            |
| 22   | AgroSoyuz Spassk LLC | 12,345.3 | 2,597.6 | 14,942.9 |
| 23   | Agrofirm KriMM LLC | no grant in 2019 | no grant in 2019 | |
| 24   | SHP Michurinets Closed Joint Stock Company | 0 | 8,468.7 | 8,468.7 |
| Total: | 302,765.6       | 135,953.9    | 438,719.5          |                                    |

In 2019, all the planned indicators of the ‘Development of breeding and seed production of potatoes in the Russian Federation’ subprogram were achieved, namely: five new domestic processes were developed for the implementation of breeding and seed production of potatoes out of a single planned; three RIAs were registered, for the use of which licensing agreements were concluded, including abroad, out of two planned; nine scientific units, infrastructure facilities, etc. (table 2) [16].

The upgrading and creation of up-to-date breeding and seed production centers (BSPC) is also among the main results of the implementation of the subprogram. For example, in the Sverdlovsk Region, Ural Potato, a production center for the production of domestic elite potato varieties, has been established, the main task of which is to provide Russian agricultural producers with potato seeds of domestic production. At the initial stage of construction, 25 million rubles were allocated within the framework of state support from the regional budget and 15 million rubles from the federal one. The first stage of the center was launched in November 2017. It is planned to conduct seed production of 15 to 20 varieties, of which at least 60% are varieties of their own selection and selection of the Ural Research Institute, and 40% are varieties of Russian and foreign selection. After reaching full capacity, the enterprise will produce 10,000 metric tons of elite potato seeds annually, which will meet the needs of a number of Russian regions. Ural Potato is one of the most up-to-date BSPC for laboratory equipment. A state-of-the-art laboratory for diagnosing potato diseases using real-time PCR.
analysis allows obtaining seed of the highest quality. The laboratory of microclonal reproduction of potato plants is capable of producing more than 70,000 plants \textit{in vitro}. The greenhouse facilities are capable of producing more than 560,000 mini-tubers per year. In the first year, the planned number of 560,000 potato mini-tubers was produced, which were planted on an area of 10 hectares. In the future, it is planned to expand the planting areas and build two vegetable stores with a total capacity of 310 metric tons. Funding from the federal budget will amount to 170 million rubles [17].

Table 2. Main indicators of the implementation of the ‘Development of potato breeding and seed production in the Russian Federation’ subprogram in 2019.

| Indicator                                                                 | Target | Actual |
|--------------------------------------------------------------------------|--------|--------|
| Number of new domestic processes developed for the implementation of selection and seed production of potatoes | 1      | 5      |
| Conservation and maintenance of existing collections of potato varieties | 1      | 18     |
| Number of RIA registered, for which licensing agreements have been concluded, including abroad | 1      | 3      |
| Number of established: scientific units                                   | 9      | 5      |
| basic (joint) departments, laboratories and temporary creative teams      | 5      | 14     |
| Number of personnel engaged in research and development by area           | 220    | 390    |
| Number of new domestic competitive potato varieties developed             | 2      | 10     |
| Quantity of elite category seed potatoes produced and sold as part of the subprogram of domestic selection (MT) | -      | 2035.45|
| Number of new biological means of potato protection developed and registered | 1      |        |

In the Kabardino-Balkarian Republic (KBR), a project has been underway since 2015 to create the Zolsky Potato BSPC. Growing seed potatoes in mountainous areas allows for a virus-free seed material that is not subject to thermal degeneration and insect damage. In 2018, the BSPC together with the Kabardino-Balkarian, Gorsky State Agrarian Universities and the Institute of Agriculture, a branch of the Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences, were selected to participate in the implementation of the CSTP. Seventy million rubles were provided for the research (table 3) [16].

Table 3. CSTP financing amount and areas.

| Item | Action description                                                                 | Investment amount (mln rubles) |
|------|------------------------------------------------------------------------------------|--------------------------------|
| 1    | Construction of five elite seed potato storage facilities of their own selection with a capacity of 6,000 metric tons | 100                           |
| 2    | Construction of two greenhouses with a total area of 1,800 sq. m for growing mini-tubers | 15                            |
| 3    | Construction and equipping of the genetic center                                    | 32                            |
| 4    | Construction and equipping of two sorting centers (for elite and original seed material) | 18                            |
| 5    | Performing research and development by scientific institutions                        | 70                            |

The total cost of the project amounted to 463 million rubles for the period 2018 - 2025. The project is financed on a parity basis from the federal budget and at the expense of the industrial partner.

The implementation of the project on the territory of the KBR and the Republic of North Ossetia Alania will create an integrated system for breeding the best domestic and new original varieties of potatoes based on the maximum use of the unique favorable conditions of the virus-free environment of the mountainous zone of the KBR. From 2022, up to 5,000 metric tons of high-quality, revitalized elite-class seed potatoes will be produced annually.
The first results of the project implementation were the nutritional system for cultivated microplants developed by the specialists of Zolsky Potato LLC and the participants of the CSTP, which made it possible to increase the number of mini-tubers obtained from a single microplant to 50 pieces. Four varieties of seeds are reproduced on the seed plots of the enterprise and more than 150 hybrids are planted by employees of Gorsky State Agrarian University. More than 10 patents for inventions with elements of innovative technology have been obtained. Two varieties, Gorsky 17 and Osetinsky, bred by Gorsky State Agrarian University and reproduced by Zolsky Potato LLC, were transferred to state variety testing, according to the results of which a yield of more than 35 MT / ha was obtained within three years.

The status of the CSTP participant allowed the farm to expand the geography of its presence on the potato market both in Russia and abroad. Agreements were reached on the supply to Azerbaijan in the amount of 750 metric tons and to Iran in the amount of up to 3,000 metric tons annually from 2020. However, the key task remains to provide seed material for Russian potato growers.

According to the Federal State Statistics Service, the KBR produced 182,800 metric tons of potatoes in 2018, of which almost 52% in personal subsidiary plots (PSP), for which retail trade in seed material packed in packages of 5-10 kg was organized. Further development of the project involves cooperation with farms and agricultural organizations, which account for 48% of the gross harvest of potatoes in the region. In 2020, it is planned to establish an agricultural consumer cooperative, which will transmit virus-free seed material grown in a mountainous environment to farms located in the lowland zone of the region [18].

In the Tomsk region, Kolpakov LLC has been a customer of the CSTP titled ‘Development of new potato varieties based on up-to-date molecular biological methods, production and marketing of revitalized seed material of domestic high-reproduction potato varieties’ since 2018. The project is implemented jointly with Agrofirm Zorkaltsevskaya LLC and the Siberian Research Institute of Agriculture and Peat, a branch of the Siberian Federal Research Center of Agrobiotechnology of the Russian Academy of Sciences, which perform the scientific part of the project: the development of new varieties of potatoes of domestic breeding based on up-to-date molecular biological methods. The project will allow producing potatoes of all reproductions: 87,000 pieces of mini-tubers of the first field generation in the amount of 23 metric tons, as well as super-super-elite varieties in the amount of 100 metric tons, which will be further sold mainly to Agrofirm Zorkaltsevskaya, where super-elite seed potatoes will be produced based on these original seeds. Kolpakov LLC will produce at least 580 metric tons of elite seeds annually from original seeds. The total amount of elite seeds for all project participants is planned at a level of 1,370 metric tons annually.

The total amount of project investments taking into account all sources of financing is 453 million rubles, of which approximately 50% is the grant funds. The amount of investments in the material and technical base excluding field work will amount to 260 million rubles. The project participants, both at their own expense and the grant funds, will update the material and technical base and ensure the implementation of all processes of introducing new varieties of potatoes into crop rotation. Within the framework of the project, storage facilities having a capacity of 7,000 metric tons of simultaneous storage of potatoes will be additionally built and equipped with state-of-the-art microclimate equipment. At least eighteen jobs will be created in rural areas. The Department for Social and Economic Development of the Tomsk Region Rural Area finances the training and professional development of personnel based on the Tomsk Institute for Retraining and Agribusiness and the Tomsk Agricultural Institute. The implementation of the project will increase Kolpakov LLC labor productivity by at least 15% and revenue by 25 to 30% [19].

4. Conclusion

The state set the task of transforming agriculture through the introduction of up-to-date technology and proposed a tool to support the introduction of the latest scientific achievements, that is to say, a programmatic approach that simultaneously solves the problem of high import dependence on foreign equipment, technology, selection achievements and other production factors. To eliminate dependence
on foreign technologies and best practices, the Federal Scientific and Technical Program for the Development of Agriculture for 2017-2025 is being implemented, which provides for the introduction of domestic RIA through comprehensive scientific and technical projects that involve the coordination of the activities of all participants in the creation of scientific and technical results, and their approbation and implementation.

As part of the implementation of the CSTP activities, all planned annual targets and indicators of the subprogram were achieved in 2018-2019. An analysis of the first results of the implementation of the FSTP and the activities of the CSTP member organizations showed the sufficiency of the measures envisaged by the projects to solve the main problems that hinder the excitation of innovative activities. Successfully implemented projects, such as Zolsky Potato in the Kabardino-Balkaria Republic, Ural Potato in the Sverdlovsk Region, Kolpakov LLC in the Tomsk Region and others, show that a high degree of coordination of project participants is achieved.

The CSTP activities contain mechanisms that provide a stimulating effect on innovative activity; in particular, it stimulates the upgrading of the material and technical base for the creation and implementation of innovations through public-private partnerships. There is an increase in state regulation of the planning, creation and implementation of innovations, since they are stimulated in clearly defined areas, at the same time, grant support of scientific research is provided by the government, and the interest of organizations in the introduction of domestic equipment, processes and other factors of production is growing. An important factor of support is state co-financing, which allows reducing the influence of the factor of lack of free financial resources that manufacturers should have on the upgrading of production and the introduction of innovations.

The mechanism allows solving one of the main problems that determine the low innovative activity in the industry, that is to say, the weak involvement of the results of scientific research and development in practical activities.

The mechanism for CSTP implementing has shown high efficiency as a tool that stimulates innovative activity. It is advisable to expand its use.

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