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## Public and Private Partnership: Innovation-Driven Growth of Agriculture at the Regional Level

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### Abstract

The purpose of this study is to define the economic context related to the functioning of the agricultural industry in the regions of the Central Federal District (CFD): the main structural sectors of the industry and its main results are described, and the main trends in the productivity and sustainability of agriculture in the region are analyzed. The results of the study indicate that investing in agricultural innovation is of great importance for improving the agricultural productivity, preserving the environment, and eradicating poverty and hunger. In the context of limited resources, a public-private partnership (PPP) can become a promising mechanism for the implementation of innovation projects in the agro-industrial complex. Due to the recent changes in the legislation of the Russian Federation, PPP agreements can be concluded in agriculture, which is relevant in the current conditions of the sanctions struggle and the need for import substitution of agricultural products. The mechanism for implementing projects in the agro-industrial complex using the PPP mechanisms allows an investor to reduce costs in the investment phase, reduce project risks by sharing them with the state, and guarantee sales or return on the project.

**Keywords:** public-private partnership (PPP); agriculture; agro-industrial complex; innovation; research and development; agricultural research.

**JEL Classification:** R11; R38; R58; Q55.

### Introduction

Agriculture plays a crucial role in ensuring food security and political stability throughout the world, and yet it leaves a significant ecological footprint. The agricultural producers of the Russian Federation are faced with the

task of growing abundant, safe, and nutritious food products for a growing population of the planet in the face of climate change and pest pressure (Polushkina *et al.* 2017).

They need broad access to relevant innovations, as well as to the knowledge and skills that make these new tools valuable in agrarian production, in order to continue to produce food in a sustainable manner.

Agricultural science, technology, and innovation are vital for promoting rural development and reducing poverty. Therefore, an important issue for both researchers and policy makers is to determine how investments and policies on improving agricultural education, research, and distribution can efficiently contribute to technological changes.

The PPPs are a key mechanism for developing and ensuring a reliable flow of technology in the face of changing needs. The partnerships can efficiently bridge the gap between different areas of public and private sector competencies in order to meet the needs of agricultural producers.

Efficient partnerships can combine the competence and interests of the public and private sectors. In this case, they can increase both social and economic value. They can create faster and more sustainable innovation conveyors, secure the efficient distribution of technology, support continuous improvement, and promote the efficient and responsible application of technologies.

Organizations and farmers from the public and private sector exchange actionable agricultural information and the best practices as part of joint projects. Collaborative projects between the public and private sectors can create fundamental resources that allow farmers managing their production process more reliably, at lower cost and with less risk.

The introduction of the PPP in the field of agricultural R&D is increasingly seen as an efficient means of conducting advanced research, developing new technologies, and introducing new products in the interests of various sectors of the society (Minh 2009). However, there are few studies that empirically establish whether PPP efficiently performs this role at the regional level.

An attempt is made in this study to fill this gap by examining how the PPPs encourage increased investment in agricultural innovation at the regional level. This study will provide better understanding of the functioning of such partnerships in the region's agriculture, the problems they face, and how their activities can be improved to contribute to the country's food security.

## 1. Literature Review

There is no universal definition of the PPP at the moment. It covers a wide range of operations for which the private sector has responsibility, including investments (Marin 2009).

The surge in interest in agri-PPPs is clearly reflected in recent development literature (e.g., Spielman, Hartwich and von Grebmer 2010, Boland 2012, STDF and IDB 2012, Brickell and Elias 2013), in development agency strategies promoting private-sector engagement (BCLC 2009, MFA 2010, IFAD 2012, GIZ 2011, FAO 2013), and in the design of country-level PPP policies and laws (e.g., the Federal Law "On Public-Private Partnership, Municipal-Private Partnership in the Russian Federation" (2015)) and national agricultural development strategies (e.g., the State Program of Developing Agriculture and Regulating Markets for Agricultural Products, Raw Materials and Food in the Russian Federation (2012)).

According to the industry experts, the PPPs in agriculture have significant potential to modernize the agricultural sector and contribute to its sustainable development (WEF & McKinsey and Company 2013). The public and private institutions possess the knowledge necessary to improve global agriculture.

However, the motivation behind this approach and the loose manner in which the concept is defined raise many unanswered questions about the types of project that may suitably be governed by this mechanism, and about the mechanism's effectiveness in delivering on sustainable and inclusive agricultural development objectives (Tomich *et al.* 2019).

Cross-fertilization of theoretical contributions from other disciplines also appears to be limited, despite the plethora of literature on PPP topics from disciplines that include economics, public administration and management science (Horton, Prain and Thiele 2009).

It is important to note that there is no single definition of PPP, leaving room for loose interpretation when applying the concept. Nonetheless, valuable elements can be assembled from the definitions given by various sources, which help to clarify the concept.

A useful conceptualization is provided in the Asian Development Bank's (ADB's) PPP handbook (ADB 2008), which sees PPPs as a mechanism for improving the delivery of public goods and services by partnering with the private sector while retaining an active role for government to ensure that national socio-economic objectives can be achieved. PPPs are thus defined as "a framework that – while engaging the private sector –

acknowledges and structures the role for government in ensuring that social obligations are met and successful sector reforms and public sector investment are achieved" (ADB 2008).

The World Economic Forum (WEF) refers to the concept of PPPs as simply involving "business and/or not-for-profit civil society organizations working in partnership with government agencies, including official development institutions. The PPP concept entails reciprocal obligations and mutual accountability, voluntary or contractual relationships, the sharing of investment and reputational risks, and joint responsibility for design and execution" (World Economic Forum 2014).

Thus, in line with the WEF definition, virtually any form of collaboration (formal or informal) between the public (including donors) and private sectors (and their related partners) can be labeled a PPP, often with only limited detail on the selection process for private partners, the direct benefits for public partners, and the distribution of costs, revenues and risk (Fraczkiewicz-Wronka and Wronka-Pośpiech 2018).

While national PPP policies and laws generally prescribe predetermined project design, bidding and selection processes, accompanied by a specific set of legal and regulatory guidelines, on the promotion of PPPs for agricultural development to date has been placed limited emphasis (Schouten and Hospes 2018).

For this study, a definition by the OECD is used, in which PPP for agribusiness development is defined as a formalized partnership between public institutions and private partners designed to address sustainable agricultural development objectives, where the public benefits anticipated from the partnership are clearly defined, investment contributions and risks are shared, and active roles exist for all partners at various stages throughout the PPP project life cycle (Gaffney *et al.* 2019).

The emergence of PPPs in agriculture responds to the failed delivery of a public good, such as food security, environmental protection and the viability of rural areas (Yost *et al.* 2019). In these cases, by combining the resources and complementary capacities of both public and private partners under a well-defined legal and regulatory framework, governments can obtain economic and social benefits from public investments that they would have been unable to achieve alone because of limited technical expertise and management skills and/or a lack of resources (Payumo *et al.* 2018).

The experts have identified a typology of four common PPP project types in agriculture (Moiseenko 2018):

- partnerships that aim to develop agricultural value chains;
- partnerships for joint agricultural research, innovation and technology transfer;
- partnerships for building and upgrading market infrastructure; and
- partnerships for the delivery of business development services to farmers and small enterprises.

One of the main reasons for the development of PPP in agriculture is innovation and market access. For public partners, the added value of agricultural PPP projects results from tapping into the powerful innovation and efficiency of the private sector while promoting the pursuit of sustainable agricultural policy objectives (Khalturina *et al.* 2019).

Over the past half century, hundreds of studies have been published reporting about measures of agricultural productivity and the effects of agricultural research and development (R&D) on agricultural innovation and productivity patterns. Many studies in agriculture and knowledge dissemination emphasize the importance of public investment and policies in these areas. Agricultural innovations require investments in physical, human, and institutional capital, as well as electronic platforms favorable for farmers (Lele and Goswami 2017).

At the same time, the issues of creating favorable conditions necessary to support the formation and implementation of such partnerships after the completion of the project period are not sufficiently elaborated. Besides, the methodological aspects of assessing the effectiveness of agri-PPPs at the regional level remain poorly reviewed and need further research.

## 2. Methods

The methods of this study are based on data from the bibliometric analysis of scientific publications and statistical indicators from open sources. The statistical indicators were taken from the databases of Rosstat, the Unified Interdepartmental Statistical Information System (UISIS), and the technological platform for supporting infrastructure projects PPP Development Center. The scientific literature and analytical materials were found using public information sources and official websites of the Ministry of Agriculture of the Russian Federation, Scopus, the National PPP Development Center, OECD, and the CFD Forum on PPP.

The practical part of the study is based on the comparative analysis of indicators describing the agriculture development and the innovation-driven growth of the CFD regions.

### 3. Results of Agricultural Production and the Development of Agricultural Innovation in the CFD Regions

The CFD territory extends to 650.3 thous. sq. km and is the largest in Russia in terms of population – 39 mln people or almost 30 % of the country's population. Large markets for agricultural products, high yielding black soil, and good transport connection are the advantages of the CFD, which can be most fully implemented through the regionalization mechanisms of the agro-industrial complex.

The gross regional product of the CFD is 35 % of the country's GDP. Agriculture accounts for 3 % of the gross value added of the CFD. The CFD accounts for 27 % of the country's total agricultural production.

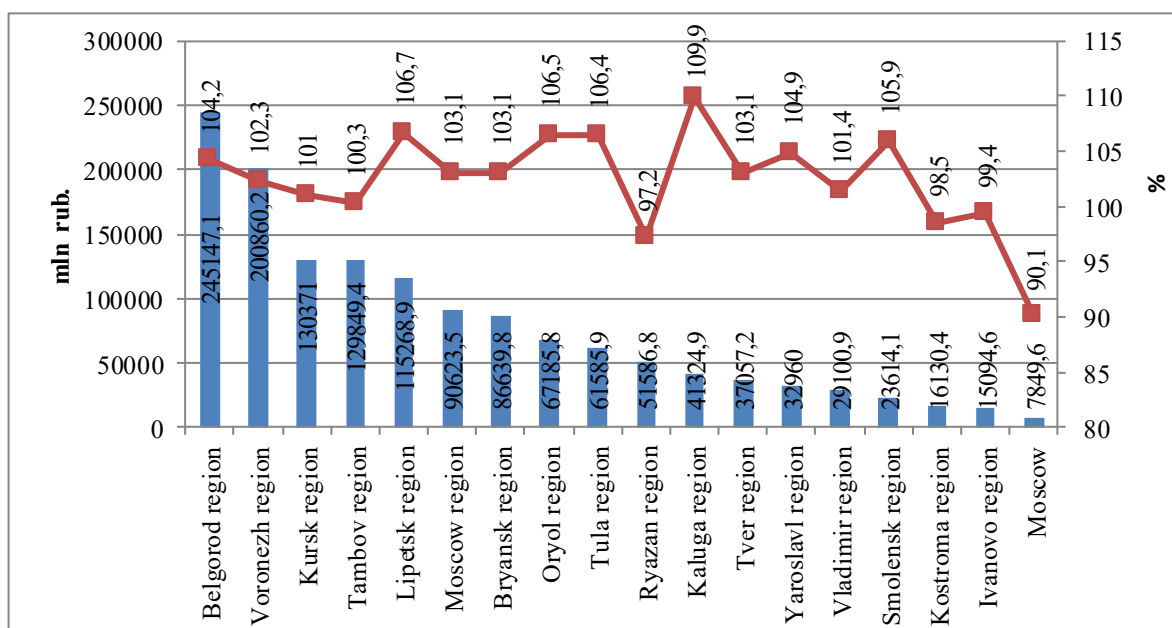
According to the 2016 agricultural census, 8,314 agricultural organizations and 23,994 farms and private entrepreneurs were registered in the territory of the CFD as of July 1, 2016. 70.3 % of the total number of the registered agricultural enterprises are active, while the share of farms and private entrepreneurs is 55.8 %.

The CFD regions vary considerably in the number of registered agricultural enterprises. The largest number of agricultural organizations operate in the Moscow (1,220), Voronezh (789), and Tver (765 units) regions. The Moscow (3,090), Voronezh (2,658), and Tambov regions (1,839) are leading by the number of registered farms and private entrepreneurs.

The lowest number of agricultural organizations were registered in the Ivanovo (241), Oryol (257), and Belgorod (289) regions. The low rate of the registered farms and private entrepreneurs is observed in the Kostroma (398) and Ivanovo (715) regions.

The CFD includes areas with different agro-climatic conditions. The CFD regions vary greatly in the agricultural production level and pace of development. The Tambov, Bryansk, Belgorod, and Kursk regions are leading in terms of the contribution of the agricultural sector in the GRP (Figure 1).

Figure 1. Contribution of the Agriculture, Forestry, Hunting, Fishing and Fish Farming sector in the GRP of the CFD regions in 2018



Source: (Rosstat 2017)

The yield of major crops per harvested area in the CFD observed a positive trend over five years (2014 – 2018): the yield of grain and leguminous crops increased from 34.8 dt/ha in 2014 to 36.4 dt/ha in 2018; potatoes – from 157.1 dt/ha to 176.1 dt/ha; oilseeds – from 16.9 dt/ha to 21.8 dt/ha; and open-ground vegetables – from 193.3 dt/ha to 201.1 dt/ha.

The productivity of livestock and poultry in agricultural organizations of the CFD has increased. For example, milk yield per cow in farms of all categories increased from 5,052 kg in 2014 to 5,785 kg in 2018. At the same time, the average egg production rate of one laying hen in agricultural organizations of the CFD decreased from 293 in 2014 to 286 in 2018.

The growth in the yield and productivity of livestock and poultry led to an increase in the agricultural production. For example, the production of livestock and poultry for slaughter in live weight increased by 20.4 %

– from 4,486 thous. tons in 2014 to 5,403.2 thous. tons. The most significant growth rate of meat production in live weight for 2014 – 2018 was observed in the Kaluga (120.1 %), Ryazan (81.7 %), and Vladimir regions (77.4 %).

At the same time, despite the increase in agricultural production, the number of high-performance jobs slightly decreased. For example, there were 149.6 thous. jobs in the Agriculture, Hunting and Forestry sector in 2014, but this indicator decreased to 147.2 thous. as on the end of 2017, *i.e.*, by 1.6 %.

The Belgorod region has been an absolute leader in terms of the number of high-performance jobs created in agriculture for several years, with 31.1 thous. jobs created there. The smallest number of high-performance jobs were created in the Kaluga (1.3 thous.), Ivanovo (1.8 thous.), and Kostroma (1.9 thous.) regions.

It must be noted that the innovation activity of large and medium-sized agricultural organizations in the CFD is generally described by a rather high level of innovative activity compared to the average for the Russian Federation. The total level of innovation activity in the CFD agriculture was 5.2 %, while the average Russian indicator was 4 %. At the same time, the investment activity of agricultural enterprises (5.2 %) is significantly lower than the similar figure in industrial production (11.9 %).

24.4 % of agricultural enterprises in the CFD use innovative technologies, such as drip irrigation, biological methods of protecting plants from pests and diseases, individual feeding systems for livestock, etc.

The share of organizations implementing technological innovations in the agricultural sector in the CFD was 3.4 % (the average figure for Russia is 1.1 %). The expenditures of enterprises in the agricultural sector of the CFD for technological innovations amounted to 4,494.1 mln rubles. At the same time, technological innovations in agriculture were carried out only in nine out of 18 CFD regions.

In 2017, domestic expenditures on R&D in agricultural sciences amounted to 5,865.1 mln rubles, which was 1.1 % of the total R&D expenditures in the CFD. More than 55 % of the costs (3,255 mln rubles) for agricultural R&D were carried out by enterprises in Moscow and the Moscow region.

Private R&D funding for agriculture is insufficient and can be explained by several reasons, such as the small size of agricultural enterprises, high cost of innovative projects and associated risks, and lack of market incentives and cooperation between the business sector and scientific organizations.

Many regulatory acts, development strategies and target programs have been adopted to support agriculture and encourage the development of the CFD regions and their innovative structure. The state programs are developed and implemented in all the CFD regions to develop agriculture and regulate the market for agricultural products.

The key tools supporting R&D in agriculture include government assignments for scientific institutions of the Ministry of Education and Science of the Russian Federation, the Federal Target Program "Research and Development in Priority Directions for the Development of the Scientific and Technological Complex of Russia for 2014 – 2020", the Innovation Promotion Fund, the Russian Science Foundation, Russian Foundation for Basic Research, and Resolutions of the Government of the Russian Federation dated April 9, 2010 No. 218 and No. 220.

Contracts for 58 projects were concluded as part of the Federal Target Program "Research and Development in Priority Directions for the Development of the Scientific and Technological Complex of Russia for 2014 – 2020", the results of which are of interest for use in agriculture and agro-industrial complex. The total funding of these projects for 2014 – 2019 amounted to 4.84 bln rub., including 2.87 bln rub. (59.3 %) funded by the state.

The Innovation Promotion Fund supported 1,494 projects in agriculture and biotechnologies for a total amount of 2.56 bln rub. in 2014 – 2017, of which 1,093 projects for a total of 0.47 bln rub. were under the Brainbox program, 272 projects for a total of 0.51 bln rub. were under the Start program, 47 projects for 0.69 bln rub. were under the Development program, 18 projects for 0.19 bln rub. were under the Internationalization program, and 64 projects for 0.70 bln rub. were under the Commercialization program.

The Russian Science Foundation has supported 160 projects in agricultural science since 2014, including one comprehensive program. 2,388 papers were prepared and published in 2014 – 2018 as part of these projects, of which 861 papers (36.1 %) were in publications indexed in Scopus, and 566 papers (23.7 %) were in publications indexed in WoS.

The Russian Foundation for Basic Research allocated funds for 178 projects with a financing volume of 0.19 bln rub. for agriculture and the agro-industrial complex of the Russian Federation in 2014 – 2018.



Despite the institutional changes aimed at improving and facilitating business access to research results by improving collaboration, the lack of cooperation between the business and research sectors of the innovation system in the CFD regions remains one of the main problems. Today, the issues of creating and introducing innovative and primarily domestic developments and technologies into the practice of the agro-industrial complex of the country are becoming increasingly relevant. Such a promising mechanism as PPP should be introduced into the practice of innovative projects implementation in the agro-industrial complex.

### 3. Discussion

The Russian agriculture faces the challenges of import substitution, increasing exports, entering new, highly competitive markets, and improving the efficiency of agricultural production. Innovations are a key component of the successful implementation of these tasks, it is a complex multilevel process. The innovation transfer should be continuous, verified, and interconnected with education, training, scientific research, and knowledge generation.

Despite economic growth in agriculture, its scientific and technological level lags behind the developed countries. The country lacks an efficient system for introducing the results of scientific research into production, a unified center for coordination, forecast and expertise of the agrarian scientific technological advances.

To overcome these shortcomings, A.V. Petrikov, the Director of the All-Russian Institute of Agrarian Problems and Informatics, suggests to create a public-private company for innovations in the agro-industrial complex and the Fund for Scientific and Technological Development of Agriculture, as well as to adopt draft laws to improve the regulatory framework for innovation-driven growth (amendments to the Federal Law "On Seed Breeding", "On Breeding", "On Veterinary Medicine", new laws "On Technology Valley" and "On Plant Genetic Resources").

The Federal Scientific and Technical Program for the Agriculture Development for 2017 – 2025 (FSTP) (Resolution of the Government of the Russian Federation No. 996 2017) became the most important instrument for the implementation of innovative projects in agriculture. Measures are being taken as part of this program of the scientific and technological agriculture development to reduce the level of import dependence in the agro-industrial complex, restore the base of livestock breeding, produce new domestic varieties of plants, and create new high-quality feeds and medicines for animals, and fertilizers.

The FSTP is fulfilled through the implementation of subprograms for some types of agricultural products, raw materials and food that are most demanded. The first subprogram was adopted in May 2018, titled "Development of potato breeding and seed production in the Russian Federation". The FSTP was supplemented with the second subprogram in December 2018, titled "Development of sugar beet breeding and seed production in the Russian Federation".

The goal of these subprograms is to secure stable growth in industrial production and sales of high-quality competitive seeds of profitable hybrids and domestic breeding varieties based on new high-tech Russian developments and the implementation of comprehensive scientific and technical projects of the full innovation cycle.

The FSTP will be implemented as part of comprehensive scientific and technical projects on the PPP principles, where the share of private investment should be at least 50 %.

According to Andrei Paptsov, the Deputy Director of the All-Russian Research Institute of Agricultural Economics under the Russian Agricultural Academy, despite all efforts of the Russian Government to allocate subsidies, the money allocated is insufficient for the general development of the industry. As such, attracting private investment and setting up joint projects are extremely necessary. This is a promising dimension, and it is already underway in many industries. This is a new dimension in agriculture, and it can be used in many fields of the agro-industrial complex.

According to the Center for the PPP Development, the PPP mechanisms in agriculture will be most demanded in production (dairy and greenhouse agrotechnical complexes, networks of mobile land cultivation stations for pest control, ameliorative systems and aeration networks), processing (meat packing plants, bakeries, feed mills, factories processing grain, legumes and melons), and storage (elevators, silos for storing agricultural products, vegetables and potato storages, and wholesale distribution centers).

As part of the III Forum of the CFD on PPPs, experts identified barriers to the PPP development in the implementation of innovative projects and identified ways to overcome them (Table 1).

Table 1. Barriers to the PPP development in innovation

Barriers	Measures to remove barriers
Reduction of R&D costs	<ol style="list-style-type: none"> <li>1. Subsidizing R&amp;D if there is an industrial partner;</li> <li>2. Creation of technoparks next to educational institutions;</li> <li>3. Popularization and involvement of children and young people (CYIC, quantoriums, etc.); and</li> <li>4. Accounting the costs for the technology acquisition as expenses for taxation purposes.</li> </ol>
No venture financing institutions due to the lack of quality startups	<p>Creating a special tax regime for venture funds:</p> <ul style="list-style-type: none"> <li>▪ simplified accounting reporting;</li> <li>▪ simplified loss adjustment: accounting losses for one project as expenses of another project; and</li> <li>▪ accelerated depreciation.</li> </ul>
Lack of innovation infrastructure that facilitates the creation and development of breakthrough startups	<ol style="list-style-type: none"> <li>1. Creation and development of technology-innovative platforms: business incubators; high-tech technoparks; shared centers (engineering centers, prototyping centers);</li> <li>2. Subsidizing the costs of industrial enterprises for the creation of technology implementation sites.</li> </ol>
Low level of export of high-tech goods	Subsidizing the costs of automation and digital transformation of production processes in export-focused technologies

Source: compiled by the authors

627 projects with private investments worth 553.8 bln rub. were being implemented in the regions of Central Russia in 2017, which made the region a leader. According to P. Seleznev, the Chairman of the Board of the Center for the PPP Development, the PPP management mechanisms are the most developed in Moscow and the Moscow region, while indicators of other CFD regions vary considerably.

Table 2. Potential application of the PPP mechanisms in agriculture: sectoral distribution of criteria

Sector	Crop production		Animal husbandry		
Direction	Seed selection and production	Raw materials	Selection and genetic	Raw materials	
Activity	Production and storage, p. 1	Year-round vegetable production, p. 7 Storage of grains and oilseeds, p. 8 Storage of potatoes, p. 9 Storage of fruit and berries, p. 10	Production and storage, p. 2	Meat	Milk
				Production, primary processing, storage, p. 5	Production, primary processing, storage, p. 6
Sector	Fish farming		Interdisciplinary		
Direction	Selection and genetic	Raw materials	Services to third parties		Raw materials
Activity	Production and storage, p. 3	Production, primary and subsequent processing, and storage, p. 4	Primary processing and storage (for SMEs), p. 11 Processing and storage (for centralized industry), p. 12 Primary processing and storage (capacity for manufacturers and processors), p. 13	Provision of space for production, processing and storage facilities; p. 14 Provision of storage space and services to logistics companies, p. 15	Primary and subsequent processing and storage (for the purposes of production of goods established by the Resolution of the Government of the Russian Federation No. 2524-r dated November 28, 2016), p. 16

Source: compiled by the authors

Despite the decent performance of the CFD, there was a big gap in the PPP development in the district: from 90.1 % as the first position to 7.8 % as the 80th position. Most of the projects were presented in the social sphere, public utilities, and transport sector. At the same time, no projects were implemented in the agricultural sector.

D. Butsaev, the Deputy Chairman of the Moscow Region Government, expressed his opinion that the success of the region in the PPP development was indicated not so much by the number of PPP projects, as by the ratio of the raised private and public investments. In his opinion, this allows adjusting the work of regional teams.

With the adoption of the Federal Law No. 391-FZ dated December 29, 2015, the legislation on PPP (115-FZ and 224-FZ) was extended to agriculture. The adoption of the Resolution of the Government No. 1686 "On the approval of criteria for classifying objects of production, primary and (or) subsequent (industrial) processing, and storage of agricultural products as objects of a concession agreement, public-private partnership or municipal-private partnership agreement" became an important step towards the agri-PPP development.

The resolution provides for groups of criteria for various agricultural objects, compliance with which allows concluding concession and PPP agreements. In total, 16 separate lists of such criteria were approved for objects in crop production, animal husbandry (including milk and meat), aquaculture (fish farming), vegetable production, storage of grains and oilseeds, vegetables, fruits and berries, etc.

The experts of the National Center for the PPPs have developed potential types of objects and models of using the PPP mechanisms in agriculture, which are clearly presented in Table 2.

According to the market experts, the following points of growth can be found for the PPP market in agriculture in the CFD regions:

- Creation of project offices (interdepartmental bodies) for packaging the PPP projects, as well as specialized institutes for pre-project support of municipal PPP initiatives (in a similar way to the creation of the Fund in the Moscow region);
- Definition of a concept for the communal infrastructure development within the regions (technical and commercial servicing, heat supply, water supply and wastewater disposal) and a procedure for the interaction between the regional and municipal authorities during its implementation;
- Transition to the "portfolio" management in the PPP (creation of the regional PPP programs); and
- Further improvement of the regulatory and methodological framework in PPPs in the regions.

## Conclusion

Further development of the agricultural industry is impossible without technical and technological modernization and innovation-driven growth, which in turn entails the need to arrange modern, high-tech industries and to increase the level of workers' professionalism and performance.

The agricultural sector in the CFD regions is described by weak agribusiness demand for innovation and low level of innovation activity of agricultural enterprises in comparison with the industrial ones.

The PPP is one of the most promising forms of raising investment in the development of the innovation system of the regional agricultural sector. The findings of the study indicate a big gap in the PPP development indicator in the CFD regions (from 90.1 % as the first position to 7.8 % as the 80th position in the ranking).

Implementation of innovative projects using the PPP mechanisms will secure the sustainable development of agriculture in each region, increase agricultural productivity, and create new jobs. This, in turn, will have positive impact on the investment attractiveness of the region and, consequently, can increase the regional budget revenues.

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