

The Mechanism of Public-Private Partnerships as an Important Element of the Development of Irrigated Agriculture

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Abstract. Stable development of agrarian production in arid climate conditions demands a large-scale integrated water management of land, that allows to provide high and stable yields of agricultural crops. Today, such a task is especially relevant in the arid regions of different countries of the world and Russia, where land reclamation is already actively developing in practice. To solve this socially significant task, the accurately organized interaction of the state and the private sector is required. An effective tool for the interaction of the state and private business in the production of agricultural products on irrigated lands is the Public-Private Partnerships (PPP) mechanism. PPP has already proved its effectiveness in solving many socio-economic problems in various countries of the world, and is actively developing in Russia. The modern mechanism PPP is able to compensate for the budget deficit and to solve especially important problems of irrigation amelioration development. PPP is an alternative to the privatization of vital, state-owned objects of strategic importance. The most effective form of public-private partnership to improve the efficiency of irrigated farming is determined based on the use of the BOO-Build, Own, Operate-construction-ownership-management model ensuring the private partner's ownership of the facility during and after the agreement period.

1. Introduction

To date, a large number of scientific papers have been devoted to the development of public-private partnerships in various sectors of the economy. Public-private partnerships are actively developing around the world in Asia, Africa, Europe, North and South America. In these regions, China [30], Tanzania [15], Greece [17], Brazil [1], and the United States [20] are particularly noteworthy. Some scientists are comparing various aspects of the development of public-private partnerships, features, advantages and disadvantages of its implementation in different countries of the world [27]. At the same time, land reclamation and irrigation technologies in agriculture of various countries are actively developing. Irrigation is especially in demand in the arid regions of the planet. Therefore, a significant part of the scientific work is devoted to urgent problems of the development of land reclamation in agriculture in the countries of the Middle East, such as Egypt [25], Iran [12], Pakistan [22], as well as in the South of North and Central America – the USA [4] and Mexico [14]. The same attention is paid to irrigation in the southern arid regions (risk farming zones) of Russia and other countries of the Eurasian Economic Union (EAEU) – border Kazakhstan. But, despite the fact that a large number of publications have been published on the two above-mentioned topics, at the same time insufficient attention is paid to the development of irrigation systems based on public-private partnership mechanisms. But in such a complex and costly industry as land reclamation, in the development of which the state

and private business of public-private partnership are interested, can become the basis for solving the main problems.

2. Relevance, the scientific importance of the question with the short review of literature

At the same time, mechanisms of public-private partnership (PPP) are actively developing in Russia today. For example, in the “Concept of Long-Term Socio-Economic Development of the Russian Federation for the Period Until 2020” this term is mentioned 20 times. In particular, on the basis of PPP, it is supposed to ensure a course towards the following strategic guidelines for long-term socio-economic development: transition to innovative socio-economic development through structural diversification of the economy based on innovative technological development and increasing the level of interaction between the state, business and society, as subjects of innovative development. The construction of PPP mechanisms and institutions is planned in the areas of the development of culture and the media, the labor market (employment of the population), increasing the availability of housing, social security (education and health) and the development of civil society (interaction of the state, population and business), monetary and budgetary policies (investments in the development of transport, energy and other infrastructure).

Thus, in order to understand and determine the differences between PPP, it is necessary to dwell in more detail on its features, which, in accordance with the procedure, evolved as a result of its historical development and international experience in application. The foundations of PPP in its modern form were laid in the United States more than 200 years ago. And at the beginning of the twentieth century, thanks to this, the consequences of the Great Depression were overcome due to the development of infrastructure projects, especially the construction of a national road network. In wide international practice, the organization of interaction between the state and business in the form of PPP has begun to develop actively since about the 1980s and to this day more than \$ 80 billion is attracted annually to the world economy on its basis. And in just 20 years from 1990–2009, according to the World Bank, more than 4.5 thousand PPP projects were carried out in developed countries with a total volume of attracted investments of \$ 1.5 trillion. In many countries, special organizations have been created to coordinate PPP development, for example, in the USA – The National Council for Public-Private Partnerships, and in Scotland - the Edinburgh PPP Council [26].

Today, PPP is mainly used in the implementation of capital-intensive projects in the field of energy, transport and utilities (up to 16% of the total), where the leaders are the countries of the Asia-Pacific region (APR), which implement about a third of all projects and accumulate about 50% of the global investment. China (a tenth of investments in PPPs) and twice as much as India is leading in the APR. In South America, another BRICS country uses PPP more actively than neighbors (BRICS – a group of 5 rapidly developing countries of the world: Brazil, Russia, India, China, South Africa) – Brazil [26].

One of the leaders in the area of irrigated land in Russia is the Saratov region. In the Saratov region, one of the directions in the development of agricultural production was the restoration of the system of irrigated agriculture in the Volga region. In the 80s of the last century, the area of irrigated land in the Saratov region exceeded 500 thousand hectares, and even today, despite a half reduction during the years of reform, it remains the largest in the Volga region [23]. Only the development of the reclamation irrigation system will allow to solve the problems of import substitution, both in the areas of crop production and in the livestock industry by stabilizing feed production [5, 29]. In recent years, the region has set a course for the development of irrigated agriculture [6]. As part of the XII forum of interregional cooperation between Russia and Kazakhstan in Sochi in 2015, an agreement was signed on cooperation between the Saratov and West Kazakhstan regions on the implementation of the project for the development of reclamation systems. The project provides for an increase in the area of irrigated land in Russia (about 200 thousand ha) and Kazakhstan (about 50 thousand ha). It will be implemented by the Buket group of companies with the support of the Eurasian Development Bank [2]. At the regional level, there is also a right-wing consolidation of PPP. For example, in the Saratov region, Law No. 62-LSO “On the participation of the Saratov region in public-private partnership”

was adopted on April 28, 2010. A law that establishes goals, objectives, principles, order, as well as forms of participation of the region in PPP. Moreover, the law defines the participation of the region in PPP as a set of forms of medium- and long-term interaction between the region represented by the Government or another authority, on the one hand, and a private enterprise on the other hand, with the aim of implementing regional investment projects and targeted programs. Among the forms of participation of the region in PPP the following are listed: equity participation in the authorized (joint-stock) capital of legal entities, leasing, rent, concession, creation and attraction of funds from investment and venture funds. The main types of state support for PPP are: tax incentives and loans, state guarantees, preferential rental rates, consulting, information and organizational support, provision of collateral fund facilities to ensure obligations when attracting investments. The objects of PPP agreements proposed objects of transport, utilities and social infrastructure, objects of the use of natural resources, security and law and order, as well as management objects.

Various organizational, economic and technological aspects of the development of melioration and irrigation are the work of many scientists from around the world: A.A. Chernyaev [7], V.A. Yaroslavsky [8], D. Sary [25], S.U. Rehman [22], M. Hooshmand [12], Y. Chen [4], S. Juarez-Hernandez [14].

The modern theory and practice of the development of public-private partnerships in various sectors of the economy of many countries of the world are reflected in the works: G.V. Gordenko [10], L. Zhang [30], N. Kavishe [15], M. Marinelli [17], L.G. Araujo [1], D.A. Nguyen [20], S. Tsukada [27].

3. Formulation of the problem

The objective of the study is to consider the theoretical and methodological foundations of PPPs and to select the most effective forms of application in the field of land reclamation and irrigation, allowing to achieve the highest possible indicators of cost recovery for agricultural producers. For this purpose, it is required to develop a PPP mechanism and model, as well as justify their economic efficiency, which allows confirming the solution of the task.

4. Theoretical part

The study of scientific publications of domestic and foreign authors revealed a variety of formalized models of PPP, which is due to the evolutionary development of relations between the state and business in various areas of the economy [10] (agricultural production in general, and land reclamation in particular, are not an exception) of various states. The legal system of a particular state and the peculiarity of the development of its institutional structures form the corresponding mechanism (form) of a PPP in their country. Thus, it is possible to structure the lists and interpretation of existing forms and mechanisms for the implementation of PPP for any state or classify them according to their functional characteristics, for example, the degree of participation of the state or a private partner in the implementation of various stages of the project. The substantial difference in the formalized mechanisms for implementing PPPs by country also makes it difficult to compile them. Therefore, we can state the diverse approaches to the classification of mechanisms for implementing investment and financial PPP projects, models and forms that are used by leading international organizations and financial institutions: United Nations, Organization for Economic Co-operation and Development (OECD), International Bank for Reconstruction and Development (IBRD), International Finance Corporation (IFC), World Bank Group, United Nations Commission on International Trade Law (UNCITRAL). The urgency of combining the interests of the state and business in the form of a public-private partnership is increasing due to the desire of agricultural producers to minimize the risks and costs, efficient use of existing resources, advanced technologies [21, 24, 11, 28].

Significant forms of mutual cooperation between government agencies and private companies that are commonly accepted in practice are: BOT – Build, Operate, Transfer – construction-management-transfer (the private partner uses the object and does not own it); BOO – Build, Own, Operate – construction-ownership-management (a private partner becomes the owner of the object from the beginning of the PPP project and remains its owner in the future); DBFM – Design, Build, Finance, Main-

tain – design-build-finance-operate (a private partner is included in the agreement process at the initial stage and performs all the functions of the participant until the end of the agreement) [3].

Under the implementation of the PPP mechanism from the standpoint of the functionality of its main elements, we should understand a structured mechanism (implementation method) of PPP that has been tested in practice, representing, by definition, the very concept of such partnership [9], the established system of redistributing obligations and risks between partners (project delivery system): design, construction, reconstruction, financing, management, operation, maintenance, leasing, transfer.

5. Practical importance, offers and results of introductions, results of experimental studies

As a result of a study of the current state of the irrigation network in the conditions of the arid climate of the Volga region, we evaluated the possibility of upgrading the small-scale irrigation system using the public-private partnership mechanism. The choice of research methods was determined by the specifics of the tasks to be solved, the objects of study, the nature and sources of obtaining the necessary information. Therefore, they used: economic-statistical, experimental, design-calculated, balance, abstract-logical methods, expert assessments, as well as system analysis, comparative analysis and statistical grouping.

To unify the proposals and the possibility of their distribution to a wide range of objects, all the presented data and the results of the calculations are reduced to an area of 100 ha. In accordance with the previous studies, the amount of funds required for the implementation of this project is planned in the amount of 42 350 thousand rubles.

The economic efficiency of the proposed irrigation system modernization project was assessed using certain provisions of the Russian Methodological Recommendations for evaluating the environmental and economic efficiency of agricultural land reclamation investment projects (hereinafter referred to as the Methodological Recommendations) [18], as well as the methodology for evaluating the effectiveness of a public-private-municipal partnership project and determine their comparative advantage [19]. The applied economic approaches of these methods are similar and relevant for the global practice of evaluating the effectiveness of projects [13, 16].

The proposed project will entail a change in the structure of cultivated areas on irrigated land. The share of maize for grain and fodder crops will increase significantly from 26 to 65% (due to a decrease in the area of grain to 25%). This will provide feed for the growing livestock industry, the expected area of cultivation of vegetables will be 4% of the total area. Modernization of the irrigation system provides increased yields of cultivated crops. Winter grain crop yield from 1.2 to 4.0 tons with ha, spring grain – from 1.0 to 3.5 tons with ha, maize for grain – from 2.5 to 6.0 tons with ha, etc. In accordance with the methodology, the commercial efficiency of the project was estimated taking into account the crop yield during the development period, which should be: 70% of the project crop yield in the first year, 90% in the second year and 100% in the third and subsequent years. The analysis of the corresponding change in the gross yield as a result of the implementation of the irrigation system modernization project under the PPP agreement is presented in Table 1.

The modernization of the irrigation system is all that is associated with the need for reimbursement of costs associated with the production, storage, transportation, processing and production of products, as well as associated with the provision of irrigation networks, conducting agrochemical works and others [3]. Net current costs on average per 1 ha of irrigated area after the modernization of the irrigation system under the PPP agreement will amount to 30 070 rubles, while on the area without modernization – 10 520 rubles on 1 ha. Received on this basis, the expected increase in income from manufactured products is 5 669 110 rubles. The cost of agricultural products used as animal feed was estimated by the value of the grain by converting the grown products into grain units.

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Table 1. Changes in the gross harvest of crops as a result of the implementation of the irrigation system modernization project under the PPP agreement.

Crops	Structure of sown areas, %		Crop yield, tons with ha			Total yield, tone	
	before imple- men- tation of the project	after imple- men- tation of the project	before implemen- tation of the project	after implemen- tation of the project	deviation (+/-)	before implemen- tation of the project	after implemen- tation of the project
Fallow land	15.00	–	–	–	–	–	–
Winter grains	20.00	10.00	1.23	4.00	2.77	34.62	40.00
Spring grains	26.00	5.00	1.04	3.50	2.46	27.04	17,50
Maize for grain	3.00	10.00	2.59	6.00	3.41	7.76	60,00
Sunflower on grain	10.00	–	0.87	–	-0.87	8,70	–
Soya	–	3.00	–	2.00	2.00	–	6,00
Grain legumes	–	3.00	–	2.50	2.50	–	7,50
Vegetables	–	4.00	–	40.00	40.00	–	160,00
Maize for silage and green fodder	11.00	15.00	12.09	35.00	22.91	132,98	525,00
Perennial grasses for green fodder	–	15.00	–	40.00	40.00	–	600,00
Perennial grasses for hay	–	20.00	–	7.00	7.00	–	140,00
Annual grasses for green fodder	10.00	5.00	7.07	18.00	10.93	70,70	90,00
Annual grasses for hay	5.00	10.00	1.79	4.50	2.71	8,95	45,00

Source: Own calculation

Each investment project for construction, reconstruction or modernization of the land reclamation industry must have commercial and public efficiency. Calculation of commercial efficiency is carried out in accordance with the criteria for evaluating investment projects based on the determination of indicators characterizing the ratio of flows from all types of activities and their movement over time

(discounted growth in net income; payback period, internal rate of return and investment profitability index, calculated with discounting). Based on the provisions of Methodological recommendations¹⁰ to build models of cash flows and determine project performance indicators, the calculation period is set to 12 years. The characteristics of the investment climate and the high uncertainty of the project results were taken into account. In accordance with the results obtained, the profitability of turnover without the project would have been 9.97%, whereas after the implementation of the project – 65.80%. In determining the effectiveness of an investment project, it is recommended to use a discount rate of 50% of the discount rate set by the Bank of Russia, which at the time of settlement was 9% per annum. On this basis, the discount used in the calculations, we set at 4.5% (0.045). Taking this into account, we analyzed the dependence of the efficiency of the irrigation system modernization project under the PPP agreement on the share of the public partner (Table 2).

Table 2. Changes in the effectiveness of the irrigation system modernization project under the PPP agreement depending on the share of participation of the public partner.

Variables	Efficiency of the project at various options of participation of public and private partners				
	Project in general	10 ^a – 90 ^b %	30 ^a – 70 ^b %	50 ^a – 50 ^b %	70 ^a – 30 ^b %
Increase of net profit, kRUB	28352.67	32587.67	41057.67	49527.67	57997.67
Discounted increase in net profit, kRUB	12047.20	16282.20	24752.20	33222.20	41692.20
Simple payback period, yrs	8	8	6	5	3
Discounted payback period, yrs	10	9	7	5	3
Internal rate of return, %	9	12	18	30	58
Yield index expenditures	1.37	1.42	1.53	1.63	1.74
Yield index discounted expenditures	1.18	1.24	1.36	1.48	1.59
Profitability Index	1.71	1.71	1.71	1.71	1.71
Profitability Index discounted Investment	1.31	1.31	1.31	1.31	1.31

Source: Own calculation

^ashare of participation of the public partner

^bshare of participation of the private partner

A change in the financing model towards an increase in the share of participation in a public partner project significantly affects the change in the values of the main performance indicators. In particular, subject to an increase in the financing of the project at the expense of the public partner in the scheme from 10 to 70%, the increase of net profit increases by 77.97%, the internal rate of return increases by 4.8 times, the payback period of the project decreases to 3 years.

In Figure 1 is presented dependence of an increase of net income and internal rate of return on change of shares of participation of private and public partners within the agreement on PPP. By increasing the share in the investment load and reducing the burden on private business, project performance indicators improve and its attractiveness to a private partner increases. Apparently from dependence, at increase in investment load of the public partner higher increase of net income is provided and the internal rate of return increases that is reflected in faster payback periods of the project. The calculations of options for the participation of public and private partners in investing the project allow us to prove its economic efficiency. The project as a whole is characterized by a short payback period, and with an increase in the share of financing of the public partner to 70%, it was reduced from 8 to 3 years.

Definition of economically reasonable distribution of investment loading between public and private partners is an important task. However now there are particular restrictions of the budgetary financing that doesn't allow the state to undertake the bigger volume of investment. Under these conditions, the most rational ratio of investments in the irrigation system modernization project under the PPP framework is the scheme: 50% participation of the public partner and 50% participation of the agricultural commodity producer.

Thus, according to the planned scheme of 50:50 percent, the share of the corresponding participants accounts for 21 175 000 rubles. Thus, with the parameters set forth in the model, the payback period will be 5 years, which is two times faster than with the implementation of the project without concluding an agreement on PPP. Starting from the third year of the project implementation, when the project yield is reached, the income from product sales will be 5 785 590 rubles. As a result, the cash flow balance on an accrual basis in the fifth year of implementation will become positive and will amount to 4 174 670 rubles, increasing further annually for the amount of income. Thus, over 12 years, the Increase of net profit of the project will reach 49 527 670 rubles.

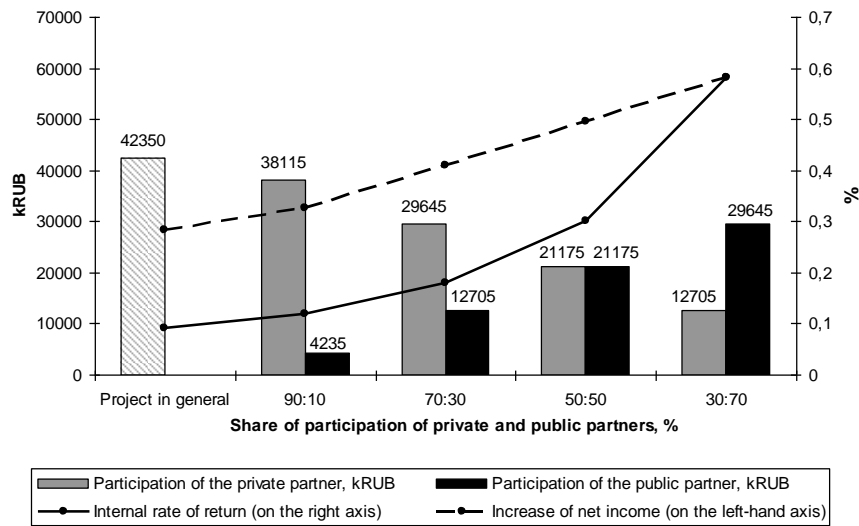


Figure 1. Dependence of the increase in net income and the internal rate of return of the irrigation system modernization project under the PPP agreement on the share of the public partners. Source: Authors.

6. Conclusion

In addition to the estimated commercial results, the development of irrigation amelioration in a dry climate will allow you to: create a competitive infrastructure for the development of highly efficient crop production; provide the population of the region with food necessary to maintain a high level of quality of life; provide sufficient water to the rural population; create conditions that allow to increase the number of working personnel by 10%; create a feed base that will be an impetus for the development of animal husbandry.

Based on the assessment of the implementation of the irrigation system modernization project using the PPP mechanism, it can be concluded that irrigation farming efficiency is improved by applying the BOO – Build, Own, Operate model – construction-ownership-management, which provides for a private partner the right to own the property during and at the end of the term of the PPP agreement.

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