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METHODS FOR EVALUATING THE EFFECTIVENESS OF INNOVATION PROCESSES

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Abstract

The experience of many countries indicates that there is no alternative to innovation processes in the national economy of any country. The intellectual component of a state, industry, region should be evaluated by the level of innovative technologies, designed to be not only highly costly, but also highly effective. Their profit should pay off considerable expenses of the innovation like when venture financing. An algorithm is proposed for evaluating the effectiveness of innovation taking into account the time factor, since the modern market economy is characterized by high risks like inflation, uncertainty of many social, economic, political conditions and factors. The evaluation of investment in innovation, taking into account the time factor, makes it possible to identify the effect of the innovation in detail, bring it closer to the real situation at the investment market and take into account changes in the value of money over time, since investment in innovation has a significant time lag. This feature should be taken into account when implementing innovation, evaluating its effectiveness, financing innovative projects, striving to level out or reduce to zero the negative impact of external factors independent of the investor. The innovative processes taking place in the regional agro-industrial complex can be evaluated as sluggish, due to the low profitability of the industry. Therefore, direct and immediate participation of the state in supporting innovation can give them an impetus, which will significantly activate the mechanisms of innovation and investment processes.

1. Introduction

Innovation includes activities related to their search, organization, preparation and practical application that can improve production efficiency in any area of the national economy. The priority area of innovative activity includes innovation focused on modernization and technical re-equipment of all system-forming industries in the region including agribusiness, where the creation of a modern material and technical base based on the innovative component is a key factor in the growth of production volumes and labour productivity. Thus, innovation is associated primarily with capital expenditures, which should bring considerable profit in the nearest future, therefore it would be quite fair to evaluate the effectiveness of innovation processes in the agro-industrial complex as investment taking into account the time factor (time lag).

2. Problem Statement

A lot of publications are devoted to innovation in the agro-industrial complex. Nevertheless, not much native and foreign research in journals is devoted to the innovative efficiency in agriculture, especially from the time of their development. First of all, this is due to a limited database for their evaluation, the lack of widespread practical experience in implementation, and the low level of coverage of many sectors of the national economy and especially the agricultural production sector by this important economic process. It is time to put into practice the theoretical research and developments devoted to this current direction. Otherwise, the country's agricultural sector will face technical and technological backwardness, reduced economic efficiency and productivity, and financial activities, as well as a loss of competitiveness and the ability to enter the foreign market.

3. Research Questions

Innovative processes in the industry were covered in many scientific publications. For example, modern scientific research on innovation has developed forecasting models for the scientific and technological development of agriculture, in particular, forecasting models for the innovative development of agricultural production with a choice of the most priority areas for innovative development (Adadimova & Polulyakh, 2020). Other authors believe that investment and innovation under the economic sanctions of the EU and the USA contribute to the creation of conditions for import substitution (Chernova & Kheyfets, 2020). Some scientific works are devoted to the connection of science and the transfer of its knowledge and innovative achievements directly to the agricultural production environment by the creation of an industrial cluster focused on the digitalization of the industry and capable of high-level integrated development and transfer of innovations and training of highly qualified specialists who adapt to the requirements of the digital economy (Popova et al., 2020). The issues of the formation and functioning of the innovative infrastructure, its nature and the fundamentals of foresight research are described (Shumakova, 2019). Some authors see innovations as a way to increase labour productivity, preserve the environment and eradicate poverty by implementation through the mechanism of public-private partnerships (PPPs), given the important factor to curb them,

namely, the limited native agriculture with financial resources for their implementation (Dudin et al., 2019). In addition, several authors consider agricultural innovative education of an economic orientation as a source of regional competitiveness (Reznichenko et al., 2016). A number of studies prove the need for the formation of regional innovation-oriented cluster systems in order to increase the efficiency of agricultural production, providing an example of the agricultural sector of the Russian Far East (Shashlo & Petruk, 2017). Other works are devoted to the introduction of innovations in small and medium-sized businesses in the agro-industrial complex, because, from the point of view of their authors, financing of small and medium-sized businesses will increase the competitiveness of the industry by intensification of innovative processes, overcome the technical and technological backwardness of the agricultural sector and food industry (Gulyayeva et al., 2016). Research of foreign scientists allows seeing the connection of innovative technologies with problems of biodiversity conservation and environmental protection. From their point of view, the application of technological innovations in mixed farming systems can preserve the flora and fauna of the Caribbean islands (Gourdine et al., 2012). Various aspects of the innovative development of the agricultural sector of the national economy were covered in other works of scientists. For example, a number of publications reflect the idea that innovation is a part of the country's agrarian policy (Ushachev et al., 2019; Sandu et al., 2015; Nechaev & Voloschenko, 2012). Others show priorities of innovation and investment policy in the agro-industrial complex in the face of risks and uncertainty to increase the efficiency of agricultural production. The need for state support for investment and innovation is substantiated (Ternovykh et al., 2017). The main directions of innovation activity were also formulated in our works, arguing that low innovative activity of regions in the agricultural sector will lead to a significant lag of the country from the advanced global economies, to the loss of competitiveness of products manufactured by the industry (Gusev & Sycheva, 2018). The study of innovative processes in the agricultural sector of Russia, indicates the need for significant state financial support for innovation, because low profitability of the industry, but at the same time its high socio-political significance for the country, dictate the urgent requirement of direct participation of the state in financing agriculture from all levels of budgets, and first of all, the federal one, where considerable financial resources are concentrated (Sycheva & Gusev, 2020).

Thus, the stated directions of scientific research in the field of innovation indicate their key role in the successful development of the economy of any country, because in developed countries, from 50 to 90% of GDP growth is achieved thanks to innovation and the technological process (Shumakova, 2019). The presented studies of native and foreign scientists confirm the multifaceted nature of the problem being studied, the level of its significance for most developed countries, primarily for Russia.

4. Purpose of the Study

As practical experience shows, the evaluation of the effectiveness of financial investment in a particular type of production and economic activity is based on a comparison of costs with the output of products, their implementation and obtaining financial results (profit, loss). To assess the effectiveness of innovative processes, it is considered possible to focus on the same methodological approaches as when assessing the effectiveness of investment costs. The effectiveness of innovative activity is influenced by a set of factors that should be taken into account when investigating innovative processes, such as the

degree of market demand for an innovative product and its usefulness to the consumer, which determines the level of consumer willingness to purchase an innovative product. It is also important whether the innovative product withstands the competitive price, as the lower the cost, all other quantitative and qualitative characteristics being equal, preference will be given to a cheaper one. In this case, it is advisable to evaluate the effectiveness of innovation, using an indicator of the level of profitability of the innovation process. Given these approaches, there is a need for optimizing the costs of innovation, finding opportunities for their reduction, which will contribute to the growth of profit and profitability at enterprises (organizations) introducing and mastering innovation. The volumes of production of innovative products and, consequently, the growth in revenue from their sales should outstrip, and moreover significantly, the growth rate of costs for innovation. Only under such conditions, the expanded reproduction of the innovative product will be carried out as well as its replication and understanding of the essence of innovative transformations. It is practical experience and a significant positive financial result that will serve as a criterion for evaluating the effectiveness of innovations. It is important to analyse and assess the innovative processes in the national economy, including its agricultural sector that will help identify bottlenecks and gaps in their development, outline ways and develop measures that stimulate innovative activity. Such a scrupulous evaluation is able to determine the key factors of growth (decrease) in the effectiveness of innovations, the significance level and the degree of influence of each factor on the final result, which will contribute to the selection of the right priorities among the many existing directions for the development of innovative processes. The key parameter for evaluating the effectiveness of innovations is the profit (profitability) indicators and the level of profitability of innovative activities, which should be analyzed and assessed that is the purpose of the presented research.

5. Research Methods

Let us consider the innovation process as an example of one of the strategic industries of Ryazan region, the AIC, where these are only emerging and have very modest results. Nevertheless, this will allow conducting a comprehensive evaluation and study of their current state, outline key areas of activation and improvement already at the initial stage of their establishment. According to the statistical data information base on the total costs of innovative activities in the region and the costs of industry innovations, their share in the total volume of manufactured and shipped products is 80-83%. These parameters can be used to calculate the amount of funds spent on innovative activities, both in the whole region and in the industry. When carrying out a comprehensive evaluation of the effectiveness of innovation both in the region as a whole and in the agricultural sector, one can confidently say that the profit and, as a consequence, the profitability of innovative processes in the region are at a very low level. At the same time, the agro-industrial complex demonstrates slightly higher results in comparison with the average regional efficiency indicator, which indicates that innovations in the agricultural sector respond more quickly to product growth, return on investment. Nevertheless, the current level of innovation profitability both in the region as a whole and in the agricultural sector is far from optimal (Table 01). To identify the reasons for such low efficiency, a comprehensive analytical evaluation and in-depth study of the existing economic situation is required in order to identify gaps and shortcomings in innovation,

smooth out negative processes and trends, outline the points of growth of profit and profitability of industry innovations.

Table 1. Comparative evaluation of the economic efficiency of innovative processes

Parameter	2016		2017	
	in the whole region	including agro-industrial complex	in the whole region	including agro-industrial complex
The volume of innovative goods, services, total, million rubles	282,217.9	18,007.2	301,256.9	19,123.5
Share, %	100.0	5.1	100.0	6.3
Costs of innovation (technological, marketing, organizational), total, million rubles	234,240.1	14,405.7	24,123.9	153,54.8
Share, %	100.0	6.1	100.0	6.4
The financial result of innovation, million rubles	+47,977.8	+3,601.5	+53,564.3	+3,987.6
The level of profitability of innovation, %	20.5	25.0	22.0	25.9

As calculations show, innovative products of the agro-industrial complex so far do not occupy the proper share in the total volume of innovative goods, works, services (5-6%). This indicates a significant lag of the agricultural sector from the advanced industries of the region. But the profitability level being above 25% in comparison with other sectors of the region indicates that the agro-industrial complex is more susceptible to innovation and meets the relatively high results of financial and economic activities. Thus, for agriculture, innovation is a means of achieving a higher effect, in comparison with the regional average parameters.

A market economy is a living organism where various economic processes take place. There are constant changes in exchange rates, securities, investments. In these conditions, it is important to assess the cost of investing financial resources correctly and objectively. Evaluation of the effectiveness of innovation should take into account its time period in order to adjust over time the changing cost of investment resources in innovation. In this case, it is also advisable to conduct an analytical evaluation of the effectiveness of innovations taking into account the time factor and using the appropriate methodology for their evaluation. The cost of money in the context of inflationary processes can be adjusted and oriented, for example, to the average cost indicators of long-term loans prevailing in a country (region) at the time of evaluating the effectiveness of innovations. In order to have objective calculations, one can take the size of interest rates on investment loans in the leading banks of the country (region). For an example and a reliable evaluation of the results of the calculations, the average interest rate was taken on investment loans in the leading banks of the region, formed as a result of inflation expectations in the 1st quarter of 2020, which for investment loans as of this period ranged from 8.0% up to 13.5%. With these indicators, the proposed calculation algorithm (Formula 1) can be applied to evaluate the effectiveness of the innovation process:

$$Ef_e = \frac{Pr}{I_{exp} + (I_{exp} \cdot c_{infl})} \cdot 100\%, \tag{1}$$

where Ef_e is the economic efficiency (profitability) of the innovation process.

Pr is profit (income) from an innovative activity.

I_{exp} is the total capital expenditure on innovation.

C_{infl} is an inflation-adjusted coefficient.

The proposed parameter is subject to analytical decomposition into components in order to determine the influence of key factors on the effectiveness (efficiency) of innovations. We will conduct analytical evaluation will take place on the example of the innovative project of the agro-industrial complex and its effectiveness will be evaluated taking into account the time period (lag). The initial data for the calculation are presented in Table 02.

Table 2. Economic efficiency of the innovation project for the development period of 2015 and 2017

Parameter	2015	2017	Change for the period, +/-
Innovation costs, million rubles, total, including	2,405.1	2,975.5	+570.4
total capital expenditure (I_{exp})	1,941.6	2,256.9	+315.3
current	463.5	718.6	+255.1
Revenues (profit) from the innovation project for the implementation period, mln. rub. (Pr)	295.7	513.7	+218.0
The average annual interest rate on investment loans granted by commercial banks to manufacturing enterprises in the country (region), % (C_{infl})	16.5	12.1	-4.4
Capital expenditures increment total to the current time level, mln. rub.	2,020.9	2,325.3	+304.3
Efficiency (profitability) of the innovation project, taking into account the adjustment for the time period ($Ef_{e \text{adj.}}$), %	13.1	20.3	+7.2
Efficiency (profitability) of the innovation project without taking into account the adjustment for the time period (Ef_e), %	15.2	22.7	+7.5
Adjustment deviation, %	-2.1	-2.4	-4.5

The evaluation of investments in innovations taking into account the time factor makes it possible to evaluate the effect of innovations thoroughly and reliably, bring it closer to the realities of the current situation at the investment market and, moreover, take into account changes in the value of money over time in the process of making financial investments in innovation because it has a significant time period, consisting of design stages, implementation and development. The effectiveness of the innovation process, taking into account the adjustment for the time period in 2015 amounted to 13.1% and it was 20.3% in 2017. The non-adjusted efficiency was 15.2% and 22.7%, respectively, the adjustment deviations in both cases were very significant, namely 2.1% and 2.4%, which confirmed the need and relevance of updating innovative processes over time. Based on the initial indicators, it is possible to evaluate the key parameter - the economic efficiency of the innovation process, taking into account the time factor. The influence of a certain range of factors on the change in the effective indicator is successively determined by elimination (Table 03).

Table 3. Comparative analytical evaluation of the effectiveness of an innovative project taking into account the time factor

Parameter	2015	2017	Deviation (+/-)
Capital expenditures for an innovative project (I_{exp}), mln. rub.	1,941.6	2,256.9	+315.3
Revenues (profit) from the innovation project for the implementation period, mln. rub. (Pr)	295.7	513.7	+218.0
The average annual interest rate on investment loans granted by commercial banks to manufacturing enterprises in the region, % (C_{infl})	16.5	12.1	-4.4
Efficiency (profitability) of the innovation project, taking into account the adjustment for the time period ($Ef_{e\text{adj.}}$), %	13.1	20.3	+7.2
The total deviation of the efficiency indicator (profitability) of the innovation project, % including due to:			+7.2
1) the effect of parameter "income (profit) from the innovation project for the implementation period"	22.7%-13.1%=+9.6%		
2) the effect of parameter "average annual interest rate on investment loans on innovations provided by commercial banks to manufacturing enterprises in the region"	23.1%-22.7%=+0.4%		
3) the effect of parameter "capital expenditures on the innovation project"	20.3%-23.1%=-2.8%		
Parameter identification	+9.6 %+0.4% +(-2.8%)=+7.2		

The key role in the level of profitability of innovations is exerted by the size of profit (income) from innovation. The level of influence of this parameter was (+9.6 pp). A somewhat lower interest rate on investment loans (+0.4 pp) also played a positive role in evaluating the effectiveness of an innovation project. The growth of capital expenditures for innovative activities had a negative impact on the integral indicator of profitability at the level of (-2.8 pp). The negative impact of parameter "capital expenditures on the innovation project" is a kind of indicator of the investment process in innovation, indicating that the investment process should be slightly suspended in order to find out how much the incurred costs of the profitability (payback) of the innovation project correspond to. For that one should resort to a predictive analysis of the dynamics of the above indicators and to continue investing in a case of some positive growth trend in economic efficiency and suspend that in a case of negative growth. In the calculation process, the adjusted interest rate on investment loans related to innovations was taken into account, which made possible reliable evaluation of the results of innovation activities.

6. Findings

The efficiency of innovative processes taking place in sectors of the national economy, including the agricultural sector should be evaluated thoroughly. Due to the fact that investment in innovation takes a long period of time, the calculation of the economic effect of investment activity in this direction should be made taking into account the time lag. In a market economy, the price of money, as well as investment resources, changes over time. So, when evaluating the economic efficiency of investing financial resources in innovation, this key factor should be taken into account. When solving this problem, it is proposed to evaluate the economic efficiency of investment activity in innovations taking into account this parameter. To do that it is necessary to determine the effectiveness (profitability) of an innovation

project taking into account adjustments for the time lag, which allows, most reliable and objective taking into account changes in the cost of financial resources in space and time, and therefore to determine the effect of innovation more closely to reality. The analytical method of decomposition into key factors affecting the efficiency of the innovation process allows identifying bottlenecks and gaps in financing of innovations. This calculation method allows identifying the level of tension in the investment process, to determine the moment when it is necessary to make an important decision whether to continue further investing at this level of intensity, or suspend it temporarily or abandon completely.

7. Conclusion

It is shown that innovative processes in the agricultural sector should be financially supported by all levels of government, as it is a contribution to the future of the country, a guarantee of stability and business solvency, competitiveness at the world market. Studies show that the innovative processes taking place in the agro-industrial complex are characterized by low activity. The industry has limited size, and sometimes a complete lack of financial resources necessary for large-scale innovation. Direct state financial support for innovations in the industry will quickly launch the mechanisms of innovation and investment processes, and federal financial resources should occupy the predominant share in the structure of sources. Evaluation of the effectiveness of innovation should be carried out taking into account the time factor. Practical experience in introducing innovations indicates that technological innovations related to improving production processes in the industry prevail among technological, organizational and marketing innovations in the regional agribusiness. It is this area of innovation activity that will further create the prerequisites for stimulating and developing marketing and technological innovations, as thanks to the improvement of technology, the application of innovative production technologies, the market will be saturated with innovative products and goods, the issues of improving techniques, methods for selling high-quality innovative products and quick delivery to the consumer will become relevant. In this case a wide field of activity will be formed for the application of marketing and organizational innovations that stimulate very difficult, but very relevant processes for the sale and marketing of innovative goods and services.

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