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Risk Assessment of Land Reclamation Investment Projects

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***Abstract*—The specific investment projects and the use of effective innovative methods of effectiveness calculation of the planned activities are important factors in profitable capital investment. The authors prove the need of studying the effectiveness assess of investments in land development using a common economic theory. It aims to speed up the formation of the methodical directions of accounting risks meeting the reclamation practices requirements. The purpose of the study is to improve the theory of assessment effectiveness of reclamation activities on the basis of synthesis, analysis and development of the effectiveness output of specific investment projects considering the risks. The analysis of the economic efficiency of the LRIP is based on the investment activities of the federal target program "Land reclamation development of agricultural land in Russia for 2014-2020." The investment usefulness in the federal target program activities of land development considering risk assessment was realized by methods of qualitative and quantitative analysis: sensitivity and scenario analysis. In the process of qualitative analysis significant risk factors are: an increase in investment costs, in discounting rate, a change in operating costs and purchasing of prices for agricultural products. It is shown that the pure present project value is the most dependent on discount rate. It is due to the exponential dependence of the future value of money from this parameter. The risk level of program implementation calculated by scenario analysis is 13.5%. This demonstrates investment feasibility in its implementation. The need for normative and methodological improvement of the current tools risk evaluations is demonstrated. It is based on the automated assessment of LRIP risks by the method of Monte Carlo.**

Keywords—risk assessment, analysis methods, investment projects.

I. INTRODUCTION

The risks of land reclamation investment projects (LRIP) are considered as the possibility of deviations from the goals arising from the external (legislation, market reaction on agricultural production, competition, etc. [1]) and internal factors (project staff competence, the falsity of definition of project characteristics, etc. [2]). They are integral features of market environment in transition economy [3]. The assessment of those risks includes [4]: an identification of all their causes, a determination of the occurrence probability and the establishment of the consequences of potential losses [5]. The purpose of the risk analysis is to provide potential investors with the necessary data for a decision making on whether to participate in the project and to take steps for a protection from possible financial losses [6].

The main factor in profitable capital investment is the knowledge of the specifics of particular investment projects and the use of innovative methods of effectiveness calculation of the planned activities [7]. The most common link between the risk probability and the projected income of an investor seems logical: the higher the profitability of investments, the greater the risk of not achieving. A profitability reduction increases the possible lack of risk costs. The project risks are divided into general or systematic, which have impact on all forms of investment activity and all investment participants, and internal reflecting the specifics of each project. The priority internal risks of investment in projects are [8]: design estimate documentation defects, etc.; a nonperformance of incurred obligations by an executer carrying out land reclamation investment projects; goal and priorities changes of the project participants in development activities; an invalidation of knowledge about financial position and

business reputation of the project participants; a call for loans due to a nonperformance of incurred obligations by an executer. Common risks include results from changes of foreign and domestic economic environment, which determine a reduction of rates in the stock market, exchange rates, purchase prices for agricultural products, an increase in the discounting rate and other negative factors.

In general, the procedure of risk management means [9]:

- to establish a possible risk and its quantitative assessment;
- to define a management methodology according to the calculation of costs, results and implementation effectiveness (a risk acceptance, an investment transfer, a risk reduction, a rejection of innovations, an impact on the risk);
- to regulate and correct the management system of investment risk. It is known that the implementation of these procedures requires a well-developed theory, a methodological and regulatory base and an experience testing of proposed approaches.

Unfortunately, it is necessary to pay attention to the absence of a developed risk accounting practices in the calculation of the LRIP effectiveness based on the innovation theory. This theory corresponds to the specifics of land reclamation activities; the fact is proved in the works of Russian researchers [10]. Thereby, the organization of large-scale research to assess the investment effectiveness in land reclamation, information collection and systematization received with the use of the common economic theory is good to speed up the methodical direction formation of the accounting risks meeting the requirements of land reclamation practices [11].

II. MATERIALS AND METHODS

Methodological problems of risk evaluation of LRIP were studied on the example of the economic efficiency of the federal target program project "Land reclamation development of agricultural land in Russia for 2014 -2020" (hereinafter the investment project), the concept of which approved by the decree of the Government of the Russian Federation on January 22, 2013 No. 37-R [12]. Techno-economic indicators of the Program for the land reclamation development are presented in Table 1.

An assessment and a risk accounting were made by the methods of qualitative and quantitative analysis [13]. For the analysis the strict structuring of cash flows was carried out from the realization of project investment on inflows and outflows by activities types (investment, operating and financial) and design phases (pre-investment, investment, implementation, completion) [14].

The qualitative analysis was used to identify specific risk types of the project having impact on a cash flow formation as well as possible risk causes according to expert assessments and analogies. Using quantitative analysis based on the information received from the qualitative analysis, the numerical values of the risks were established by the sensitivity and scenario analyses of investment projects.

TABLE I. TECHNO-ECONOMIC INDICATORS OF THE PROJECT OF LAND RECLAMATION

Indicator	Units of measurement	Effectiveness		
		Public	***Commercial***	***Budget***
Amount of investments	billion rubles	185.78	92.89	185.78
Sales receipts	billion rubles per a year	28.90	28.90	
Taxes payable to budget	billion rubles	63.38	14.19	63.38
Environmental effects from the restoration of soil fertility	billion rubles per a year	2.55	2.55	2.55
Prevented damage from flooding and underflooding of adjacent areas	billion rubles per a year	10.0	10.0	10.0
Creating new vacancies	thousands of vacancies	92.89	92.89	92.89
Pay-back period	years	8.0	5.0*	7.0

* Without providing subsidies for reimbursement of up to 50% of the costs of agricultural producers for the construction, reconstruction and technical re-equipment of land reclamation systems for general and individual use and separately located hydraulic structures owned by them or transferred to them in the established order, the payback period increases to 8 years.

At the same time, the model for defining the economic efficiency of LVIP was used on the basis of the net present value (NPV) from project investment and operating activities [15]. The project risk level was considered as a possible decrease in the expected NPV determined from the following dependencies:

$$\text{NPV} = \sum_{m} f_m \alpha_m \quad (1)$$

where $\sum f_m$ is the balance of the cash flow on the m-step; α_m is a discount factor; the amount applies to all of the steps in the calculation period; m is the number of years in the period under review. $\alpha_m = 1/(1+E)m$; E is a rate of discount.

As the original modeling data were used: investment costs, operating costs, financing conditions, project schedule. For the computer implementation of calculations on the model the upgraded complex of the subprograms were modernized. This complex was developed on the basis of electronic spreadsheets MS Excel of the software Microsoft Office, which allows to automate routine operations, reduce time and cost of labor [16].

III. RESEARCH QUESTIONS

The main risk types of implementation of LRIP are:

- a production risk associated with the possibility of a nonperformance of incurred obligations by an executer carrying out land reclamation investment projects;

- a financial risk, which determines the possibility of a call for loans due to a nonperformance of incurred obligations by an executer;
- an investment risk, which establishes the possibility of depreciation of the investment and financial portfolio as well as the failure of investing money in their own real investment;
- a market risk, which characterizes the possible fluctuation of market interest rates on the stock market and exchange rates [17].

In the process of qualitative analysis, the following significant factors were identified, on the basis of which the risk quantification of LRIP was carried out: construction risks (an increase in investment costs), financial risks (an increase in discounting rate), risks of project life cycle (changes in operational costs and purchasing prices for agricultural products). According to the sensitivity analysis (Fig. 1) the project NPV depends on the discount rate. It is due to the exponential dependence of the future value of money from this setting [18].

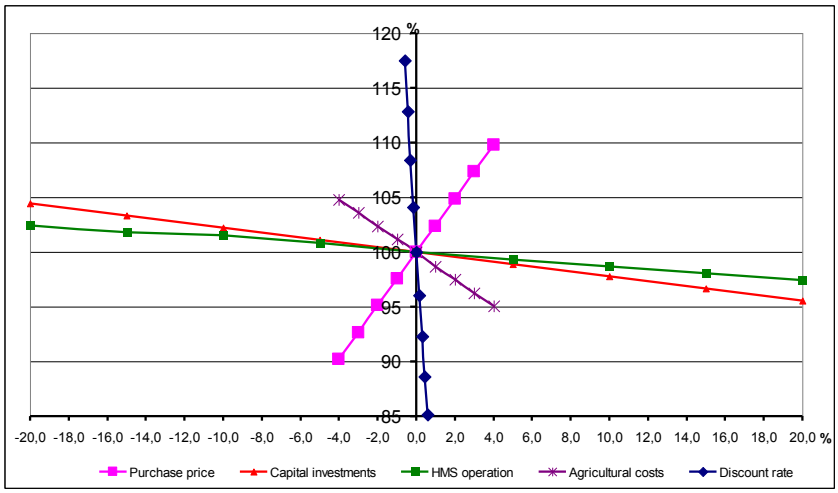

Fig. 1. The analysis of the sensitivity of the NPV to climate factors

At a constant rate of discounting the purchase prices and the costs of agricultural production play the important role. In order to reduce the risk of these factors a special attention is required to carry out the investment project [19]. So, it is necessary to strengthen the marketing program and (or) to improve the quality of agricultural products that reduce the risk of product prices. To remove the severity of the material cost factor, it is advisable to improve relations with suppliers, to concluding long-term contracts that reduce the purchase price of raw materials, and to use high-performance and resource-saving technologies water conservation operating systems and agricultural production [20].

The relatively low risk of investment costs for agricultural producer is due to the substantial share of public support in the structure of total installed cost of the investment project, reaching 50%. It confirms once again the importance of state regulation of land reclamation. The weak dependence of the NPV from operational costs of hydrotechnical constructions are due to the low weight coefficient of these constructions in the cash flow of the LRIP in comparison with capital investments [21].

Despite all the undoubted benefits (theoretical clarity, simplicity of calculation and visualization of the results) the sensitivity analysis does not allow to quantify the project while at the same time changing several variables. In this connection, the risk assessment of investment project was made using the method of scenario analysis that belongs to a class of multiple methods. Its essence is about the assigning of different scenarios for the project implementation, the determining of the scenarios realization and he weighted average value of NPV, the deviation from which is used as a risk measure [22].

According to the scenario analysis along with a basic list of initial parameters other characteristic lists of parameters are considered. They take place in the project implementation. As the law of probability of distribution project parameters, the law of the normal distribution was adopted. The values of mathematical expectation of parameters was taken equal to the values obtained in the evaluation of the project economic efficiency (basic version); ranges of standard deviations of parameters were determined on the basis of the analysis of the macroeconomic indicators [23]. Certain values for the "bad" confluence of circumstances (high inflation, low selling price, high cost of agricultural products, etc.) and for the "good" one are presented in Table 2.

TABLE II. VALUES OF PARAMETERS ON SCENARIOS OF CALCULATIONS

Parameter	Scenario		
	Basic	*Pessimistic (+/- from basic)*	*Optimistic (+/- from basic)*
Investment costs	100	+10	0
Discount rate	8	+4	-3
Purchase price of grain	100	-50	+20
Working cost of GMS	100	+20	0
Agricultural expenses	100	+30	0
Investment outlay	100	+10	0

The results of the calculation of cash flow from the implementation of basic (settlement), optimistic (good) and pessimistic (bad) versions of the project [24] by year are shown in Fig. 2.

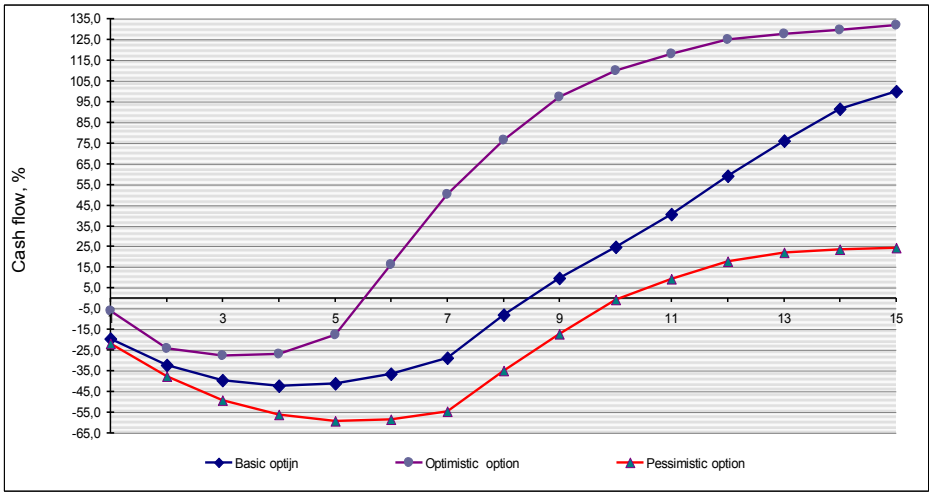

Fig. 2. The cash flow from the project scenarios by years

The weighted average value of NPV for equiprobable scenario conditions for the project realization was compared with its calculated (basic) value (Tab. 3).

TABLE III. CALCULATED NPV AND RISK ON SCENARIOS OF CALCULATIONS, %

Scenario	**NPV**
Optimistic NPV	135
Base NPV	100
Pessimistic NPV	24,6
Weighted average NPV	86,5
The risk (a deviation of the weighted average value of NPV from the basic NPV)	13,5

As a risk measure the deviation of the weighted average value of NPV was accepted from the another one, which is calculated in a percentage. The calculated risk level of the implementation of the program "Development of the land reclamation up to 2020" was 13.5%. It allows to classify it as a medium one (Tab. 4) and demonstrate the feasibility of investment in the program.

TABLE IV. THE LEVELS OF INDIVIDUAL PROJECT RISKS

No. PP	Levels	Assessment, %
I	Minimum	≤ 10
II	Average	≥10 and ≤ 25
III	High	≥25 and ≤ 30

The scenery method of risk calculation, of course, is more perfect than the sensitivity analysis. However, it has its own disadvantages associated with the subjective formulation of forecast scenarios, that is why it can increase the risk of forecast errors presence.

Unfortunately, the considered risk assessment techniques of LRIP widely spread abroad and in many domestic economy sectors (oil, gas, etc.) are on the periphery of the theory and practice of the land reclamation investment design and analysis. This relates to the development of methodical and calculated tools of risk assessments of LRIP and to the demand for risk evaluation in competitive examination of projects.

Nowadays even large-scale LRIP carried out at the federal level do not contain quantitative assessments of risk. The same can be said about the project "Land reclamation development of agricultural land in Russia for 2014 -2020". Few risk assessments of LRIP are presented without settlement studies and a minimum of meaningful interpretation. The meaningful interpretation reduces the objectivity of conclusions about the project viability and the adequacy of its technical and economic indicators.

The urgent solution to these problems will reduce the risk associated with the project implementation. It will contribute to the increase of investment attractiveness of the land reclamation on domestic and foreign markets. In addition, we should pay attention to the normative-methodical improvement of risk evaluations tools of land reclamation investment projects.

A large variety of methods for assessing the investments risks recommended in scientific literature does not save from difficulties in their practical application in the areas of the economy related to [25]:

- unreasonable proposals to use the most popular risk assessment methods for projects with differing requirements to methods of the considering economic impact feasibility;
- an dependence between the techniques used to assess according to more preferences of a developer and an

economic entity, than to the specifics of the consideration object;

- a lack of a differentiated approach to the choice of risk assessment methods in accordance with the project phases;
- an incorrect replacement of risk assessments y uncertainty assessments in the heterogeneity and exclusivity of random events;
- a lack of unification of the individual assessment methods;
- laborious calculations and an adaptation of theoretical models to specific projects parameters.

However, in scientific community there is an opinion that the risk reduction of investments is achieved by a parametric analysis of the distribution function of the probability, which is best characterized by the method of simulation modelling or the method of Monte Carlo. The simulation modelling provides: the possibility to consider the maximum number of factors contributing to a project profitability and a variability of their numerical values; calculations of a project effectiveness indicator for each scenario of a factor combination, and a formation of a probability distribution of an efficiency indicator. The availability of necessary information improves a validity of decisions about possible investment risks in a planned project and a development of preventive measures for their reduction.

In this context, it seems appropriate to use the method of simulation modelling or the method of Monte Carlo for the analysis of the reclamation projects adaptivity. The feature of the method is the ability to create arbitrary scenarios for project conditions through the generation of random values of all factors that determine each specific scenario. This deprives its disadvantages of scenario analysis and sensitivity analysis [26].

Until recently, the cause of containment to the introduction of the Monte Carlo method into a risk analysis practice was complexity and laboriousness of calculations, which are gradually being removed thanks to computer technology development and proliferation.

The software of automation means is based on the requirements of international standard ISO/IEC 17799; and they conditionally are divided into two levels: base level and the level of detailed analysis. Computer tools differ from used method of risk assessment, which may be performed at the qualitative level on the rank scale and at the quantitative level with the establishment of numerical values or the mixed level.

The most popular tools are: AIE (applied information economics), @RISK (at risk), Oracle Crystal Ball, Risk Solver Engine, SAS (Statistical Analysis System), SPSS, CRAMM, GNU OCTAVE, GRIF, COBRA, Callio Secura 17799, Proteus Enterprise, RA2, vsRisk, MSAT, RiskWatch.

The analysis shows a compliance of used methods with the normative methodical base in the part of sections Risks and Processes (the use of risk elements), and a certain proposal limitation of sections of Monitoring and Management [8-10].

According to the foregoing, it seems right to use approved, simple and successfully mastered in other economic sector toolkit at the formation stage of methods to assess investment efficiency considering the risk of its achievements in land reclamation: @RISK (at risk), the Risk Solver Engine, Oracle Crystal Ball.

The personal experience of the authors showed the usefulness of the Oracle Crystal Ball developed on the basis of the theory. This theory is characterized by clarity and simplicity of a carrying out as well as the presentation of interim and results. The "user-friendly" interface of software complex and the professionally designed description of documentation assist users in rapid and successful mastering despite their initial skills to work with Excel, which is important for a large-scale introduction of automation risk calculation into the land reclamation service.

The studies confirm the need for comprehensive and deep effectiveness evaluation of the planned reclamation activities considering the risk of its achievement. This improves the justification reliability of innovative activity by predicting the effects of taken decisions.

The effectiveness of the automated risk assessment of LRIP by the Monte Carlo method can be improved through the development, implementation, and use of the software based on the approved methods of project effectiveness assessment in land reclamation. So, there is no need to modify the working models of the analysis of LRIP and/or the adaptation of the software developed in the third sectors of the economy.

IV. Conclusion

Thus, in conditions of constant variability of domestic and world prices for agricultural products, sectoral and economy-wide standards, methods of regulation of the economy reclamation sector and other factors, which determine the investment market development, the presence of quantitative estimation of LRIP contributes to the increased demand for high-efficiency domestic projects in land reclamation.

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