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ECOLOGICAL AND ECONOMIC EVALUATION ALGORITHM OF THE REPRODUCTION OF REGIONAL INVESTMENT POTENTIAL

Abstract. The influence of environmentally caused investment losses on the value of the regional investment potential according to the phases of reproduction is investigated. The necessity of ecological and economic evaluation of reproduction of regional investment potential is proved and a corresponding evaluation algorithm is developed. The authors proposed the approaches to ecological and economic evaluation of reproduction of regional investment potential. These approaches can determine cost value of the regional investment potential taking into account environmentally caused investment losses. The results of this paper can help to solve management problems in the investment area.

Keywords: regional investment potential, reproduction of regional investment potential, ecological factor, ecological and economic evaluation, environmentally caused investment loss.

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АЛГОРИТМ ЕКОЛОГО–ЕКОНОМІЧНОЇ ОЦІНКИ ВІДТВОРЕННЯ ІНВЕСТИЦІЙНОГО ПОТЕНЦІАЛУ РЕГІОНУ

Анотація. Досліджено вплив екологічно обумовлених інвестиційних збитків на величину інвестиційного потенціалу регіону за фазами його відтворення. Обґрунтовано необхідність проведення еколого–економічної оцінки відтворення інвестиційного потенціалу регіону та розроблено відповідний алгоритм оцінки. Запропоновані авторами підходи до еколого–економічної оцінки відтворення інвестиційного потенціалу регіону дозволять визначити вартісну величину інвестиційного потенціалу регіону з урахуванням екологічно обумовлених інвестиційних збитків та приймати обґрунтовані управлінські рішення у сфері інвестиційної діяльності.

Ключові слова: інвестиційний потенціал регіону, відтворення інвестиційного потенціалу регіону, екологічний фактор, еколого–економічна оцінка, екологічно обумовлений інвестиційний збиток.

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АЛГОРИТМ ЭКОЛОГО–ЭКОНОМИЧЕСКОЙ ОЦЕНКИ ВОСПРОИЗВОДСТВА ИНВЕСТИЦИОННОГО ПОТЕНЦИАЛА РЕГИОНА

Аннотация. Исследовано влияние экологически обусловленных инвестиционных ущербов на величину инвестиционного потенциала региона по фазам его воспроизводства. Обоснована необходимость проведения эколого–экономической оценки воспроизводства инвестиционного потенциала региона и разработан соответствующий алгоритм оценки. Предложенные авторами подходы к эколого–экономической оценке воспроизводства инвестиционного потенциала региона позволят определить стоимостную величину инвестиционного потенциала региона с учетом экологически обусловленных инвестиционных ущербов и принимать обоснованные управленческие решения в сфере инвестиционной деятельности.

Ключевые слова: инвестиционный потенциал региона, воспроизводство инвестиционного потенциала региона, экологический фактор, эколого–экономическая оценка, экологически обусловленный инвестиционный ущерб.

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Introduction. The growth of the influence of environmental factor on the economic activity processes requires taking into account the environmental pollution and depletion of natural resources during the evaluation of reproduction processes in the regional economy. The reproduction cycle of the regional investment potential is being changed due to the negative influence of the environmental factor. The determining the cost value of the influence of environmental factor on the reproduction of the investment potential will allow to evaluate objectively the trends toward growth and increase of the regional investment potential in the context of sustainable development.

Analysis of recent researches and publications. Modern methodologies, according to which the evaluation of the regional investment potential is carried out, differ by approaches, terminology database, indicators, methods and evaluation criteria.

Foreign methodologies of Harvard Business School [1], the World Bank Group [2], World Economic Forum [3], the Heritage Foundation and Wall Street Journal [4] and other provide the evaluation of the investment attractiveness level. According to numerous methodologies of I.Blank [5], Z. Gerasymchuk and V. Tkachuk [6], M.Melnyk [7], T. Umanets [8] the evaluation of the investment potential, as a component of investment attractiveness of the region, is proposed to be carried through the factors of influence, expert or rating valuations, determining of the integral, aggregate indicator.

The issue of cost value of the investment potential at the state and regional levels was considered by following domestic scientists: V. Smiesov [9] M. Butko and O. Akymenko [10]. The methodology of calculating of the integral regional indexes of economic development of the State Statistics Committee of Ukraine [11] and the methodology of rating value of investment attractiveness of industries, regions and economic entities of the Ministry of Economy and European Integration were approved at the state level [12]. However, there is no comprehensive methodology on the evaluation of reproduction processes of the regional investment potential under the conditions of sustainable development and the influence of environmental factor on the reproduction of the regional investment potential is not studied enough.

Purpose of the article is to develop and ground the algorithm of ecological and economic evaluation of the reproduction of regional investment potential, which allows to take into account the value of environmentally caused investment losses.

Main results of the research. Regional investment potential is considered as the ability of the economic system of the region to ensure the formation of internal investment resources and the attraction of external investment resources and the conditions for their effective use in compliance with environmental requirements.

The main criterion of the evaluation of the investment potential reproduction is the optimum ratio between the formation, distribution and use of regional investment potential. The methodology of the evaluation of the investment potential by its reproduction phases should take into account the correlation of investment activity with the processes of the ecological and economic system development and the influence of environmental factor on the investment processes in the region.

The evaluation of the regional investment potential is based on the general theory of production factors, in particular on the determination of factor incomes as a basis for the formation of the regional investment potential. The ecological and economic evaluation of the reproduction of regional investment potential is considered as the determining of its value by reproduction phases with taking into account the environmentally caused investment losses. The algorithm of its evaluation comprises three successive stages (Fig. 1)

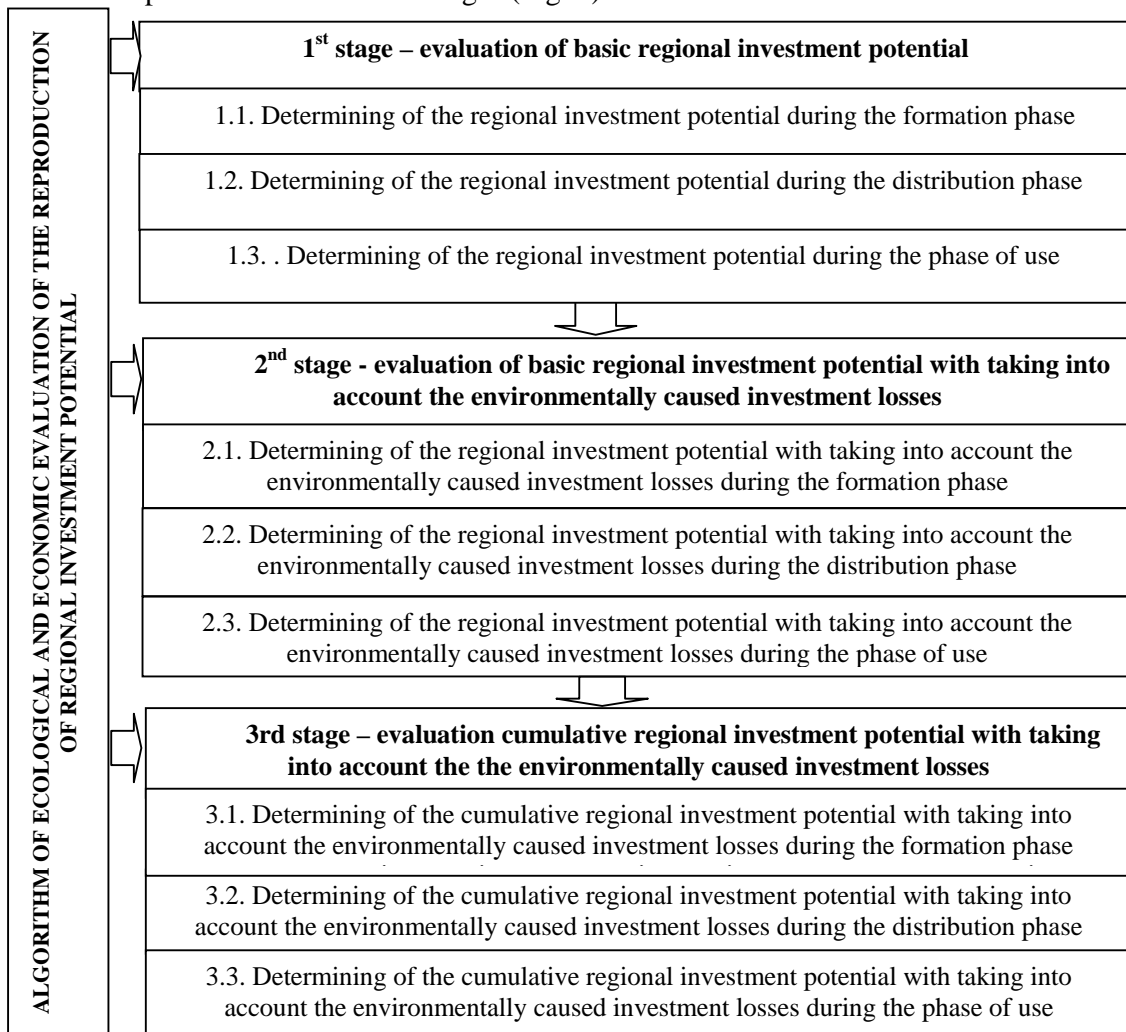


Fig. 1. Algorithm of ecological and economic evaluation of the reproduction of regional investment potential

The first stage provides the evaluation of the regional investment potential by the reproduction phases in the base year (Table 1). To evaluate the value of the regional investment potential during the phase of its formation it is necessary to determine the volume of incomes of the economic system of the region, depending on the entities that may be involved in investment

activity and are the basis of the investment resources formation. Such incomes includes: incomes of the population, enterprises and financial resources of local budgets.

On the basis of determined volumes of incomes of economic entities it is possible to determine the value of their savings, which can be potentially used to finance the investment resources. The investigation of the dynamics of formation of savings of economic entities is carried out on the basis of ratios of the distribution of their income on consumption and saving that is characterized by corresponding saving coefficients [13].

Different models of the transformation of savings into investment capital allow the households to perform the role of independent investors as well as providers of loan capital. The fund of the enterprises savings is formed by their own and external financial resources. The financial resources of the local budget on the development of some sectors of the economy are aimed at the financing of the investment projects, so they should be classified as potential sources of investment resources formation.

Table 1

Evaluation of the regional investment potential in base year

<i>1.1 Regional investment potential during the formation phase</i>	
$RIP_{form_t} = S_{inter_t} + S_{exter_t} - S_{IO_t} = (S_{popl_t} + S_{EO_t} + S_{LB_t}) + S_{exter_t} - S_{inter.outflow_t} \quad (1.1)$	
where RIP_{form_t} – regional investment potential during the formation phase in the t^{th} year, mln.UAH;	
S_{inter_t} – value of investment resources formed within region in the t^{th} year; S_{exter_t} – value of external investment resources in the t^{th} year; S_{IO_t} – value of internal outflow of investment resources from region in the t^{th} year; S_{popl_t} – amount of the savings of the population in the t^{th} year, mln.UAH; S_{EO_t} – savings fund of enterprises and organizations in the t^{th} year, mln.UAH; S_{LB_t} – the financial resources of the local budget on the development of some sectors of the economy for the t period, mln.UAH	
$S_{exter_t} = f(X_{inv.attract.}^{positive})$,	(1.2)
$S_{IO_t} = f(X_{inv.attract.}^{negative})$,	(1.3)
where $X_{inv.attract.}^{positive}$ – determining factors of positive influence on the level of investment attractiveness of region; $X_{inv.attract.}^{negative}$ – determining factors of negative influence on the level of investment attractiveness.	
<i>1.2 Regional investment potential during the distribution phase</i>	
$RIP_{dists_t} = \sum_{i=1}^k \sum_{j=1}^m RII_{form_t}^{ij}, \quad (1.4)$	
where RIP_{dists_t} – regional investment potential during the ditribution phase in the t^{th} year, mln.UAH;	
$RIP_{form_t}^{ij}$ – regional investment potential during the formation phase in the t^{th} year that is distributed by i -type of economic activity into j investment project, mln.UAH; k – number of types of economic activity; m – number of investment projects that are implemented in a region.	
<i>1.3 Regional investment potential during the phase of use</i>	
$RIP_{use_t} = \Delta GRP_t, \quad (1.5)$	
where RIP_{use_t} – regional investment potential during the phase of use in the t^{th} year, mln.UAH; ΔGRP_t – growth of gross regional product in the result of investment activity in the t^{th} year, mln.UAH.	
$m_{GRP} = \frac{\Delta GRP_t}{RIP_{form_t}}$,	(1.6)
where ΔGRP_t – growth of gross regional product in the t^{th} year, mln.UAH; RIP_{form_t} – regional investment potential on formation phase in the t^{th} year, mln.UAH.	

Source: Compiled by the authors

Thus, the investment potential during the formation phase includes the potential volumes of investment resources of the primary and the secondary, internal and external sources. They are

represented by the savings of the population, the accumulation of funds of enterprises and organizations by means of the local budget, external investment inflow and possible negative internal outflow of investment resources (form.1.1 of Table 1).

The volumes of investment resources, which come to the region from outside are determined depending on the level of investment attractiveness of the region (form.1.2 of Table 1). The factors that positively influence the level of investment attractiveness include those ones that characterize the labor, consumer, industrial, financial, institutional, innovation, infrastructural, natural and resource potentials. The high level of investment attractiveness of the region contributes to the attraction of investments and guarantees investors the profit.

Internal investment outflow of resources from the region is caused by movement of capital from one region of a country to other regions or to another country due to unsustainable social and economic development. Internal investment outflow of resources from the region is described by the function (form.1.3 of Table 1). The factors that negatively influence the level of investment attractiveness are as follows: legislative, political, economic, financial, social, criminal and environmental.

Regional investment potential during the distribution phase is evaluated by its directions structure, by types of economic activity and investment objects and is determined by the formula 1.4 of Table 1.

The phase of use is the final phase of the reproduction cycle of the regional investment potential. The result of the use of the regional investment potential is the growth of gross regional product. Regional investment potential during the phase of use is determined by the formula 1.5 of Table 1. The multiplier GRP is the indicator that characterizes the change of the gross regional product of the region relative to the volume of the investment potential during the formation phase (form.1.6 of Table 1).

The second stage is the evaluation of the regional investment potential, taking into account environmentally caused investment losses in the base year (Table 2).

On the basis of the basic regional investment potential during the formation phase its evaluation during the phase of use is grounded and it is determined by the formula 2.1 of Table 2. The interdependence of the phases of use and formation of the regional investment potential allows to determine the growth of the investment potential during the formation phase in the year next after the base year. The evaluation of the growth of the investment potential during the formation phase is carried out on the basis of GRP growth in the base year, the average coefficient of savings, the average coefficient of investment into industrial investments and the share of economic entities involved in the formation of GRP. The growth of regional investment potential during the formation phase in the year next after the base year is determined by the formula 2.2, of Table 2.

Taking into account the environmental factor during the evaluation of the investment potential during the formation phase provides the determining of the economic losses caused by violation of the ecological balance in the region. The gross regional product is the most appropriate indicator of the efficiency of the functioning of the economic system of the region that characterizes the influence of environmental pollution and depletion of natural resources on economic activity. Therefore, it is advisable to carry out the evaluation of the loss, caused to the economic system of the region, relating to the gross regional product.

Overall economic loss caused by the violation of the ecological balance is based on the calculation of its recipient by recipient components, which are manifested in the form of reduction or shortfall of their incomes that is caused by negative effects of the environmental factor influence on the capacity of entities to receive the incomes or value-added production. In economics the results of such influence are expressed in economic loss in the form of the income losses of economic entities. The environmentally caused investment loss during the phase of the formation of the regional investment potential is defined as the sum of lost incomes of economic entities in result of environmental pollution and depletion of natural resources; during the phase of distribution it is defined as the sum of the lost benefit as the investment resources are directed at the financing of the environmental oriented projects; during the phase of use it is defined as the sum of environmentally caused income losses of economic entities that are formed during the implementation of investment projects in the region [14].

Table 2

Evaluation of the basic investment potential of the region with taking into account environmentally caused investment losses

2.1 Determining of regional investment potential with taking into account environmentally caused investment losses during the formation phase	
$IRP_{use.base} = \Delta GRP_{base} = RIP_{form.base} \cdot \overline{m}_{GRP}, \quad (2.1)$	
<p>where $RIP_{use.base}$ – regional investment potential during the phase of use in base year, mln.UAH; ΔGRP_{base} – growth of GRP caused by investment activity in base year, mln. UAH; $RIP_{form.base}$ – investment potential during the formation phase in base year, mln.UAH; \overline{m}_{GRP} – average multiplier GRP.</p>	
$\Delta RIP_{form_{t+1}} = \Delta GRP_{base} \cdot \gamma_i^{GRP} \cdot \overline{k}_i^{savings} \cdot \overline{k}_i^{indust.}, \quad (2.2)$	
<p>where $\Delta RIP_{form_{t+1}}$ – growth of regional investment potential in the year next after the base year; ΔGRP_{base} – growth of GRP in base year, mln. UAH; γ_i^{GRP} – share of GRP growth by means of i economic entity involved in its formation, that is determined by the ratio of i economic entity income to the gross regional product; $\overline{k}_i^{savings}$ – average coefficient of savings of i economic entity; $\overline{k}_i^{indust.}$ – average coefficient of investment into industrial investments of i economic entity.</p>	
$RIP_{form_t}^{ecol.} = RII_{form_t} - ECIL_{form_t} \quad (2.3)$	
<p>where $RIP_{form_t}^{ecol.}$ – regional investment potential with taking into account the environmentally caused investment losses during the formation phase in t^{th} year, mln. UAH; RII_{form_t} – regional investment potential during the formation phase in t^{th} year; $ECIL_{form_t}$ – environmentally caused investment loss during the formation phase of investment potential in t^{th} year, mln. UAH.</p>	
2.2 Determining of regional investment potential with taking into account environmentally caused investment losses during the distribution phase	
$RIP_{dist.t}^{ecol.} = RIP_{dist.t} - ECIL_{dist.t}, \quad (2.4)$	
<p>where $RIP_{dist.t}^{ecol.}$ – regional investment potential with taking into account the environmentally caused investment losses during the distribution phase in t^{th} year, mln. UAH; $RIP_{dist.t}$ – regional investment potential during the distribution phase in t^{th} year, mln. UAH; $ECIL_{dist.t}$ – environmentally caused investment loss during the distribution phase of investment potential in t^{th} year, mln. UAH.</p>	
2.3 Determining of regional investment potential with taking into account environmentally caused investment losses during the phase of use	
$RIP_{use_t}^{ecol.} = RIP_{use_t} - ECIL_{use_t}, \quad (2.5)$	
<p>where $RIP_{use_t}^{ecol.}$ – regional investment potential with taking into account the environmentally caused investment losses during the phase of use in t^{th} year, mln. UAH; RIP_{use_t} – regional investment potential during the phase of use in t^{th} year, mln. UAH; $ECIL_{use_t}$ – environmentally caused investment loss during the phase of use of investment potential in t^{th} year, mln. UAH.</p>	

Source: Compiled by the authors

Regional investment potential with taking into account environmentally caused investment losses on the phases of formation, distribution and use is determined by formulas 2.3, 2.4, 2.5 respectively (Table 2).

The third stage is the evaluation of cumulative regional investment potential taking into account environmentally caused investment losses (Table 3).

The evaluation of cumulative regional investment potential taking into account environmentally caused investment losses is carried out during whole reproduction cycle of the regional investment potential. The duration of the reproduction cycle of the regional investment potential is defined as the weighted average of the life cycles of investment projects that are implemented in the region (form.3.1 of

Table 3). The evaluation of cumulative regional investment potential, taking into account environmentally caused investment losses is carried out as the sum of the investment potential in the base year and its growth taking into account environmentally caused investment losses by phases during the reproduction cycle of the regional investment potential that are brought to the base period evaluation.

Table 3

Evaluation of cumulative regional investment potential, taking into account environmentally caused investment losses

<p>3.1 <i>Determining the cumulative regional investment potential, taking into account environmentally caused investment losses during the formation phase</i></p>	
$\overline{T}_c = \frac{\sum_{j=1}^m T_c \cdot CI_j}{\sum_{j=1}^m CI_j}, \quad (3.1)$	
<p>where \overline{T}_c – weighted average period of the life cycles of investment projects that are implemented in the region, years; T_c – period of life cycle of j investment project that is implemented in the region, years; CI_j – volume of capital investments by j investment project, UAH; m – number of investment projects that are implemented in the region.</p>	
$RIP_{form.cumul.}^{ecol.} = (RIP_{form.base} + \sum_{t=0}^T \frac{\Delta RIP_{form,t}}{(1+r)^t}) - (ECIL_{form.base} + \sum_{t=0}^T \frac{ECIL_{form,t}}{(1+r)^t}), \quad (3.2)$	
<p>where $RIP_{form.cumul.}^{ecol.}$ – cumulative regional investment potential during the formation phase with taking into account environmentally caused investment loss, mln. UAH; $RIP_{form.base}$ – regional investment potential during the formation phase in base year, mln. UAH; $\Delta RIP_{form,t}$ – growth of regional investment potential during the formation phase in t^{th} year, mln. UAH; $ECIL_{form.base}$ – environmentally caused investment loss during the formation phase of regional investment potential in base year, mln.UAH; $ECIL_{form,t}$ – environmentally caused investment loss during the formation phase of regional investment potential t^{th} year, mln.UAH; r – discount rate, % ; T – duration of the weighted average reproduction cycle of the regional investment potential, years.</p>	
<p>3.2 <i>Determining the cumulative regional investment potential, taking into account environmentally caused investment losses during the duration phase</i></p>	
$RIP_{dist.cumul.}^{ecol.} = (RIP_{dist.base} + \sum_{t=0}^T \frac{\Delta RIP_{dist,t}}{(1+r)^t}) - (ECIL_{dist.base} + \sum_{t=0}^T \frac{ECIL_{dist,t}}{(1+r)^t}), \quad (3.3)$	
<p>where $RIP_{dist.cumul.}^{ecol.}$ – cumulative regional investment potential during the distribution phase with taking into account environmentally caused investment loss, mln.UAH; $RIP_{dist.base}$ – regional investment potential during the distribution phase in base year, mln. UAH; $\Delta RIP_{dist,t}$ – growth of regional investment potential during the distribution phase in t^{th} year, mln. UAH; $ECIL_{dist.base}$ – environmentally caused investment loss during the distribution phase of regional investment potential in base year, mln.UAH; $ECIL_{dist,t}$ – environmentally caused investment loss during the distribution phase of regional investment potential t^{th} year, mln.UAH</p>	
<p>3.3 <i>Determining the cumulative regional investment potential, taking into account environmentally caused investment losses during the phase of use</i></p>	
$RIP_{use.cumul.}^{ecol.} = \sum_{t=0}^T \frac{\Delta GRP_{t+1}}{(1+r)^{t+1}} - \sum_{t=0}^T \frac{ECIL_{use,t+1}}{(1+r)^{t+1}}, \quad (3.4)$	
<p>where $RIP_{use.cumul.}^{ecol.}$ – cumulative regional investment potential during the phase of use with taking into account the environmentally caused investment loss, mln.UAH; ΔGRP_{t+1} – growth of gross regional product during the phase of use in $t^{th}+1$ year; $ECIL_{use.base.}$ – environmentally caused investment loss during the phase of use of regional investment potential in base year, mln.UAH; $ECIL_{use,t+1}$ – environmentally caused investment loss during the phase of use of regional investment potential in $t^{th}+1$ year.</p>	

Source: Compiled by the authors

Cumulative regional investment potential with taking into account environmentally caused investment loss during the phase of formation, distribution and use is determined by formulas 3.2, 3.3, 3.4 respectively (Table 3).

Conducting of the ecological and economic evaluation of the reproduction of regional investment potential allows to determine the volume of environmentally caused investment losses during the period of the investment potential reproduction. The results of ecological and economic evaluation of the reproduction of the regional investment potential will contribute to the make corresponding managerial decisions on the reduction of the its environmentally caused losses. It requires the development of organizational and economic mechanism of environmentally oriented management of the reproduction of regional investment potential.

Conclusions. Grounding of the managerial decisions in the field of investment activity of the region provides the ecological and economic evaluation of investment potential reproduction. The algorithm of ecological and economic evaluation of the reproduction of regional investment potential consists of three stages. Ecological and economic evaluation is carried out by the indicators of cumulative investment potential during the phases of formation, distribution and use with taking into account environmentally caused investment losses during each phase. The criteria of ecological and economic evaluation during the formation phase is sum of net profit of economic entities (population, enterprises and organizations) that are aimed at the industrial investments with taking into account environmentally caused investment losses during this phase; during distribution phase the criterion is optimal distribution structure of investment resources by types of economic activities and investment projects that provides minimum load on the environment; during the phase of use of the investment potential of the region the criterion is the growth of gross regional product with taking into account environmentally caused investment losses.

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