UDC 330.322:504

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THE CHOICE OF AN ATTRACTIVE INVESTMENT OPTION THE ENVIRONMENTAL PROJECT

1. Introduction.

It is known that nature needs to be protected, especially in the conditions of tendencies of its exhaustion and pollution by mankind that threatens to minimize permissible potential. This thesis and Guy's theory [James Lovelock, 1995. - 148 p.] that nature will revenge and mankind will have to pay for damage and any nature protection activity demands material, financial, labor, intellectual resources prove us the fact that the concern on ecological wellbeing is always connected with alternative expenses. From here the main task follows: to provide achievement of target parameters of environmental quality with the minimum expenses, having made a compromise choice between economic development and ecological safety.

Thus one of the fundamental problems becomes the rational distribution of investment funds of the environmental protection, an assessment of efficiency of their use. In the conditions of lack of an accurate structural basis of planning, selection of the investment projects and participants for their financing there is an influence of subjectivity in decision-making, momentary political unreasonable decision and indistinct responsibility. The assessment and selection of the projects for the state and regional levels of financing from the state budget is usually carried out vaguely and it opens the scope for corruption and inappropriate use of these resources. The laws and subordinate documents don't accurately define who has to be responsible for adoption of these or those decisions and bear for this social and legal responsibility.

It is really, the state resources aren't always spent according to the accurate program concept. Ecological funds have the poor resources and it creates the risk of inefficient use of means owing to difficulties of establishment of priorities of their distribution. It proves the need for strengthening the attention to use of bases of the institutional theory.

However, any institutional reform in the sphere of quality management of the environment should be started from the creation of accurately formulated programs of the achievement of the priority purposes, including the environmental protection. The structures of the institutes and concrete financial methods have the secondary nature and they should be adapted for the specific needs of management of the programs of ecological funds expenditure.

Therefore, for successful realization of the ecological policy, the prime solution of the most priority environmental problems, and the optimum expenditure of the funds for these purposes it is necessary to provide a conceptual basis and implementers. One of the tools for these purposes is recommended to use scenario approach [Vishnevsky Valentine, Polovyan Alexey, Aleksandrov Ivan, 2011, p. 65-78]. In this case, it is required the model of planned distribution of these resources at the heart of which there can be the usefulness of the function of quality of environment integrated index. The structural elements of this model are the total amount of fund, the number of projects and the cost of each of them.

The model description.

Let us enter designations: S - budgetary investment fund of nature protection projects; $z = \{z_1, z_2, ..., z_m\}$ - the recommended nature protection projects; m - the number of projects; $c = \{c_1, c_2, ..., c_m\}$ - the cost of projects. Thus, the set of all possible sets of projects (ϕcorresponds to a case when any of projects isn't realized, for example, if $S < \min_i c_i$) is presented in the formula 1.

$$Z = \begin{Bmatrix} \varphi, \{z_1\}, ..., \{z_m\}, \{z_1, z_2\}, ..., \{z_{m-1}, z_m\}, \{z_1, z_2, z_3\}, ..., \\ \{z_{m-2}, z_{m-1}, z_m\}, ..., \{z_1, z_2, ..., z_m\} \end{Bmatrix} = \left\{ Z_0, Z_1, ..., Z_{2^m-1} \right\}, \quad (1)$$

$$| Z | = \sum_{k=0}^{m} C_m^k = 2^m \quad (2)$$

at total of such sets of projects we have (that is we have the corresponding number of combinations of the costs of projects):

where: Z – is the vector of the recommended nature protection projects;

$\mathrm{C} = \left\{ 0, \mathrm{C}_1, ..., \mathrm{C}_{2^m-1} \right\}$ - is the vector of costs of realization of all possible sets of projects (0 corresponds to a case when funds for implementation of the project are absent).

The offered functions of the usefulness of two types [1]. The first considers only the change of the quality of the environment, and the second – the change of the quality of the environment and the financial expenses, at the same time. It has the form:

$$G_1(Z_k) = \frac{Y(Z_k) - Y(0)}{100}, \qquad (3)$$

where: $Y(Z_k)$ - is the expected value of an integrated assessment of the quality of the environment after the realization k the set of projects;

$Y(0)$ - is the value of an integrated assessment of the quality of the environment before the realization k - the set of projects.

This function of the usefulness is linear at an increment of the integrated index of the quality of the environment $Y(Z_k) - Y(0)$ that is the more the expected increment of the studied index after the realization of the set of projects, the more rational the project is.

The function of the usefulness of the second type has a form:

$$G_2(Z_k) = \exp\left((Y(Z_k) - Y(0))\left(1 + \frac{S}{aC_k}\right)\right). \qquad (4)$$

It is proved that the function of usefulness of this look exponential depends from $(Y(Z_k) - Y(0))\left(1 + \frac{S}{aC_k}\right)$, that confirms the account change of value of an integrated assessment at realization of the set of projects ($Y(Z_k) - Y(0)$), and the efficiency of investments into the project ($\frac{S(Y(Z_k) - Y(0))}{C_k} = \frac{(Y(Z_k) - Y(0))}{\frac{C_k}{S}}$), where $\frac{C_k}{S}$ – characterizes the part of means of the general investment fund which is enclosed in the *k* set of projects. If $\frac{Y(Z_k) - Y(0)}{C_k} = \frac{0}{0}$, the entered function of usefulness accepts the values from the interval $[0, +\infty)$, that means that no investments are put in any project.

Thus, the task consists in that using the corresponding restrictions to distribute resources at the maximum value of function of usefulness that will lead to the increase of the integrated index of quality of the environment, and as a result to the increase of the quality of the population life.

3. The stages of model realization:

3.1 the first stage (reflects restrictions of financial resources) allows to eliminate those sets of the projects the costs of which exceed the size of projects fund and the set of admissible projects is formed by the following rule: $Z_p = Z \,/ \left\{ \bigcup_{k=0}^{2^{m-1}} \{ Z_k : C_k > S \} \right\}$, that is a set of the projects is eliminated from a set of all possible sets of projects and their costs exceed the total amount of money (S) which the subject has.

As a result the vector of admissible projects will have the formular $Z_p = \left\{ Z_0, Z_1^p, Z_2^p, ..., Z_r^p \right\}$, in which the remained sets of projects are ordered according to the increase of costs for their realization, that is $0 \le C_1^p \le ... \le C_r^p$. There is the inequality $r \le 2^m - 1$, which eliminates unreal projects, Z_0 will always be the element of a set of admissible sets.

3.2 the second stage provides usefulness function evaluation for each of the selected sets of projects and forms the following table:

Table 1

Usefulness functions for the choice of the optimum project

The admissible sets of projects	Z_0	Z_1^p	...	Z_r^p
The values of function of usefulness	$G(Z_0)$	$G(Z_1^p)$	...	$G(Z_r^p)$

3.3 the third stage (it is the choice of an optimum set of projects) selects a set of projects which will be realized as it is optimum according to the usefulness function G.

Using the table 1, we can find Z_h^p, and $G(Z_h^p) \to \max\limits_{0 \le l \le r} G(Z_l^p)$ (that is, we find a set of projects on which the function of usefulness accepts the maximum value).

If the function of usefulness accepts the maximum value for several sets of projects, the new interaction will be required:

$$H = \left\{ Z_{h_1}^p, ..., Z_{h_j}^p \right\},\ G(Z_{h_1}^p) = G(Z_{h_2}^p) = ...$$

$$= G(Z_{h_j}^p) = \max_{0 \le l \le r} G(Z_l^p),\ j \le r, \qquad (5)$$

In consequence of this, the other set of projects from the set H is chosen, and the cost of realization is minimum, that is $C_{h_b}^p \to \max\limits_{1 \le a \le j} C_{h_a}^p$.

The objectives are realized with classical simplex method, thus investment resources on environmental protection at a rate of S = 6451 million UAH are distributed according to the projects (tab. 2) taking into account the priority of the cost of their realization.

According to table 2 the following results (tab. 3) are received.

Stage 4 allows to lead x_{ij} to 100-ball scale for calculation of the expected increment of an integrated index of the quality of environment after the projects implementation (tab. 4).

Further the vector of costs of projects is received: $c = (47{,}4;\ 472{,}9;\ 262;\ 22{,}2;\ 195;350;1718{,}7;2209{,}6;68;200;639{,}1;1183{,}8)$ for the vector of projects $z = (z_1, z_2, ..., z_{11}, z_{12})$, at a preset value of money $S = 6451$ mln. UAH, where the financial restrictions are presented by an inequality: $z \cdot c \le S$.

Table 2

The list of nature protection projects taking into account their influence on the quality of the environment

z_1	The improvement of technological processes, including transition to alternative types of fuel, raw materials, energy resources.	47,4	Reduction	of emissions of volatile organic compounds	on 0,4%
z_2	The construction and introduction of new gas-purifying installations	472,9			on 3,7%
z_3	The effective increase of existing clearing installations, including their modernization, reconstruction and repair	262,0			on 1,4%
z_4	The elimination of the sources of pollution	22,2			on 0,2%
z_5	Reconstruction and technical re-equipment of the installations for ashes catching.	195,0			on 1,3%
z_6	The construction of water treatment facilities	350			The increase of power efficiency on 0,3%
z_7	The construction and reconstruction of sewer systems treatment facilities	1718,7	Reduction	of dumpings of polluting substances in the water which has been taken away from natural sources	on 1,4%
z_8	Protection of surface water by ordering of the systems of water disposal	2209,6			on 2,6%
z_9	The introduction of water purification installations of the subjects of managing	68			on 0,07%
z_{10}	The construction of the waste-processing enterprises	200		of areas under solid household waste for 0,3%	
z_{11}	The protection and soil recultivation, restoration of underground and surface water	639,1			of squares of the polluted sites at 0,8%. and dumpings of polluting substances in the water which has been taken away from natural sources for 0,5%
z_{12}	The improvement of waste using	1183,8			of areas under solid household waste for 1,5%

Table 3

The values of the ecological parameters influencing the quality of the environment before implementation of the projects

	The ecological parameters	
Projects	Before the project realization	After the project realization
Emissions of volatile organic compounds		
z_1	$x_{22} = 58{,}235$	$x_{22} = 58{,}00206$
z_2	$x_{22} = 58{,}235$	$x_{22} = 56{,}08031$
z_3	$x_{22} = 58{,}235$	$x_{22} = 57{,}41971$
z_4	$x_{22} = 58{,}235$	$x_{22} = 58{,}11853$
z_5	$x_{22} = 58{,}235$	$x_{22} = 57{,}47795$
Power efficiency		
z_6	$x_{56} = 26{,}19$	$x_{56} = 26{,}26857$
Dumpings of polluting substances in the water which has been taken away from the natural sources		
z_7	$x_{31} = 24{,}9$	$x_{31} = 24{,}55$
z_8	$x_{31} = 24{,}9$	$x_{31} = 24{,}2526$
z_9	$x_{31} = 24{,}9$	$x_{31} = 24{,}88$
The area under solid household waste		
z_{10}	$x_{37} = 0{,}11$	$x_{37} = 0{,}10967$
Squares of the polluted sites and dumpings of polluting substances in the water which has been taken away from natural sources		
z_{11}	$x_9 = 185{,}4\, x_{31} = 24{,}9$	$x_9 = 183{,}9168\, x_{31} = 24{,}7755$
The area under solid household waste		
z_{12}	$x_{37} = 0{,}11$	$x_{37} = 0{,}10835$

Table 4

The calculation of increments of an integrated index of the quality of the environment

	Ecological parameters		
Project	Before the project realization (100-ball scale)	After the project realization (100-ball scale)	$Y(z_k) - Y(0)$
z_1	$x_{22} = 35{,}29$	$x_{22} = 35{,}55$	0,003106
z_2	$x_{22} = 35{,}29$	$x_{22} = 37{,}69$	0,028729
z_3	$x_{22} = 35{,}29$	$x_{22} = 36{,}20$	0,010871
z_4	$x_{22} = 35{,}29$	$x_{22} = 35{,}42$	0,001553
z_5	$x_{22} = 35{,}29$	$x_{22} = 36{,}14$	0,010094
z_6	$x_{56} = 43{,}65$	$x_{56} = 43{,}78$	0,001899
z_7	$x_{31} = 37{,}75$	$x_{31} = 38{,}62$	0,065363
z_8	$x_{31} = 37{,}75$	$x_{31} = 39{,}37$	0,121388
z_9	$x_{31} = 37{,}75$	$x_{31} = 37{,}79$	0,003268
z_{10}	$x_{37} = 45{,}00$	$x_{37} = 0{,}033825$	0,033825
z_{11}	$x_9 = 38{,}20\ x_{31} = 37{,}75$	$x_9 = 38{,}69\ x_{31} = 38{,}06$	0,124696
z_{12}	$x_{37} = 45{,}00$	$x_{37} = 45{,}83$	0,169125

With the use of criterion function $A(\bar{z}) = \sum_{k=1}^{12}(Y(z_k) - Y(0))z_k \to \max$ – we establish the possibility of implementation of the project: partially, completely or refusal (if $z_k = 0$, that is why *k*-project is excluded from an optimum set of projects).

The numerical results of the solution of a task allowed to establish an optimum set of projects (tab. 5).

Thus, the implementation of the designated projects will provide the quality of environment improvement on 0,543125 balls with expenses 6397, 2 million UAH that makes 99,5% of all available sum.

Table 5

The results of calculation of an optimum set of projects

Projects	The improvement of technological processes, including transition to alternative types of fuel, raw materials, energy resources,, z_1	The construction and introduction of new gas-purifying installations, z_2	The effective increase of existing clearing installations, including their modernization, reconstruction and repair, z_3	The elimination of the sources of pollution, z_4	Reconstruction and technical re-equipment of the installations for ashes catching, z_5	The construction of water treatment facilities, z_6	The construction and reconstruction of sewer systems treatment facilities, z_7	Protection of surface water by ordering of the systems of water disposal, z_8	The introduction of water purification installations of the subjects of managing, z_9	The construction of the waste-processing enterprises, z_{10}	The protection and soil recultivation, restoration of underground and surface water, z_{11}	The improvement of waste using , z_{12}
Recomendatiions	0	1	0	0	0	0	1	1	0	1	1	1

The conclusions:

1) in connection with the inefficiency of investment resources use in the nature protection projects the model of optimum distribution of these funds is developed;

2) the models of two types are offered: one which shows only the change of the environment qualities and the other which simultaneously shows the change of the environment quality, expenses and financial resources and allows to optimize a set of projects on the environmental protection;

3) the implementation of the offered projects with the help of optimizing model will provide the increase of an integrated index of the environment quality on 0,54 units.

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Александров І. О., Кравець О. О. Вибір привабливого варіанту інвестування природоохоронних проектів

Рекомендовано методи вибору раціонального природоохоронного проекту при обмежених фінансових ресурсах. Основою методу є функція корисності. Критерієм оптимальності прийнято індекс якості навколишнього середовища, якій є основою забезпечення інформацією осіб, що приймають управлінські рішення на всіх рівнях ієрархії, сприяння саморегулюванню процесу інтегрування підсистем навколишнього середовища задля формування умов сталого розвитку суспільства.

Доведено, що використання методу екстремального угрупування ознак та стандартизації даних дозволяє створити моделі змінювання якості навколишнього середовища.

Ключові слова: навколишнє середовище, екологічний проект, модель, якість.

Александров И. А., Кравец Е. О. Выбор привлекательного варианта инвестирования природоохранного проекта

Рекомендованы методы отбора рационального природоохранного проекта при ограниченных финансовых ресурсах. Основой метода является функция полезности. Критерием оптимальности проекта служит индекс качества окружающей среды, который является основой информационного обеспечения лиц, принимающих управленческие решения на всех иерархических уровнях и способствует саморегулированию процесса интеграции подсистем окружающей среды для формирования условий устойчивого развития общества.

Доказано, что использование метода экстремальной группировки признаков и стандартизация данных позволяет создать модели изменения качества окружающей среды.

Ключевые слова: окружающая среда, экологический проект, модель, качество.

Aleksandrov I. O., Kravets O. O. The Choice of an Attractive Investment Option the Environmental Project

Recommended methods for selecting environmental management project with limited financial resources. The method is based utility function. The optimality criterion of the project serves as an index of environmental quality, which is the basis of the information support of persons making management decisions at all levels of the hierarchy and contributes to the regulation of the process of integration of the subsystems of the environment for the formation of conditions of stable development of society.

It is proved that the method of extreme groups of signs and standardization of data allows you to create a model of change in environmental quality.

Keywords: the environment, the environmental project, the model, quality.

Received by the editors: 24.10.2014
and final form 23.12.2014