TECHNOLOGY AND ORGANIZATION OF CONSTRUCTION

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CHOICE OF EFFECTIVE ORGANIZATIONAL AND TECHNOLOGICAL DECISIONS UNDER RECONSTRUCTION WITH CONSIDERATION FOR ECOLOGICAL MONITORING

Classification of basic ecological risks parameters is suggested to provide urban reconstruction. Technology of its mapping is considered by example of Rostov-on- Don. The program "Ecological risk management" which allows to define a number of measures reducing ecological risk at the pre-investment stage is suggested. Information model of ecological risk management under reconstruction is offered.

Keywords: innovative developments, enterprises, potential.

Introduction

Efficiency of organizational and technological decisions under urban reconstruction in modern conditions depends on availability of information on ecological risk at ini-

tial project stage. Analysis of information on ecological risk in urban area reconstruction influences the design decision when choosing measures for environmental protection and protecting population from urban hostilities.

Hazardous ecological processes in urban area brings the threat to population health, leads to quick building and ecological destruction.

Sustainable urban development makes steep demands on design documentation quality at every stage of object life cycle, accuracy and reliability of predictions. It demands information on environmental conditions using ecological monitoring data, informational technologies of data securing, processing, and storage.

Organizational and technological system of decision-making support under reconstruction with the use of geoinformational database of ecological monitoring of municipalities is offered. It provides ecological monitoring data logging, storage, and classification. Database "Ecological assessment of an area" is developed and presented in the form of accumulation reference modules (Fig. 1).

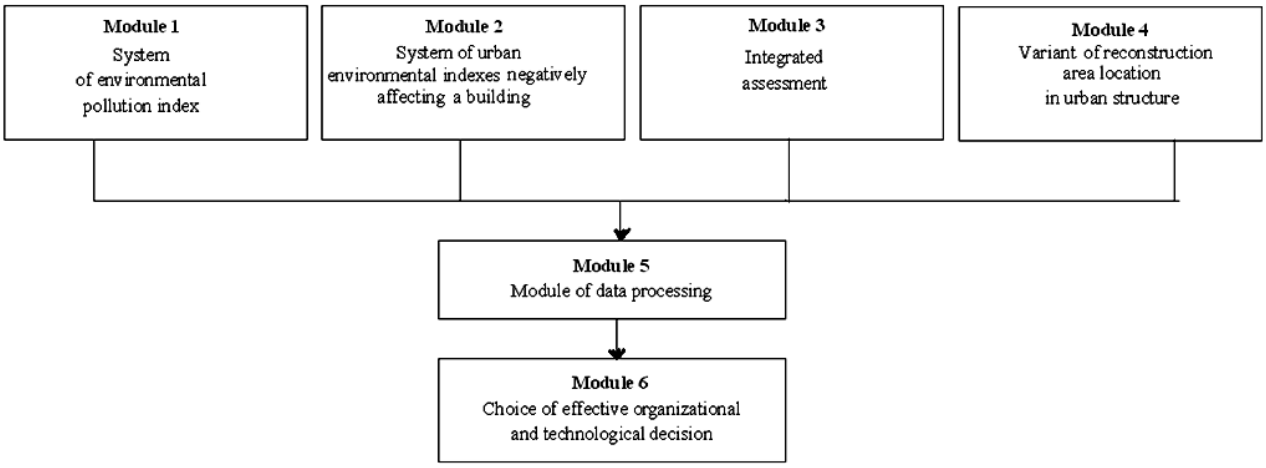

Fig. 1. The model of environmental data classification under urban reconstruction

Modules 1, 2 present information on dangerous loads on a building, environment, and a person and contains data on groundwater pollution, geological pollution over the level of microbial processes, ground pollution, air pollution, trees and shrubs, area topography, landslides, karstic and suffosion processes, and groundwater level. The information originates from geoinformational databases and is specified by results of ecological surveys.

Module 3 describes urban areas with the use of qualitative characteristics, for example, ecological risk level (see Fig. 2).

Module 4 contains information on location of object under and assessment of its surroundings. It includes information on nearest urban area components which may

magnify total loads (highways, industrial enterprises, etc). Some of these components don't change the load, they "rock the boat" (narrow streets, etc.). Some components reduce negative effects (trees and shrubs, water водные ecosystems, etc.).

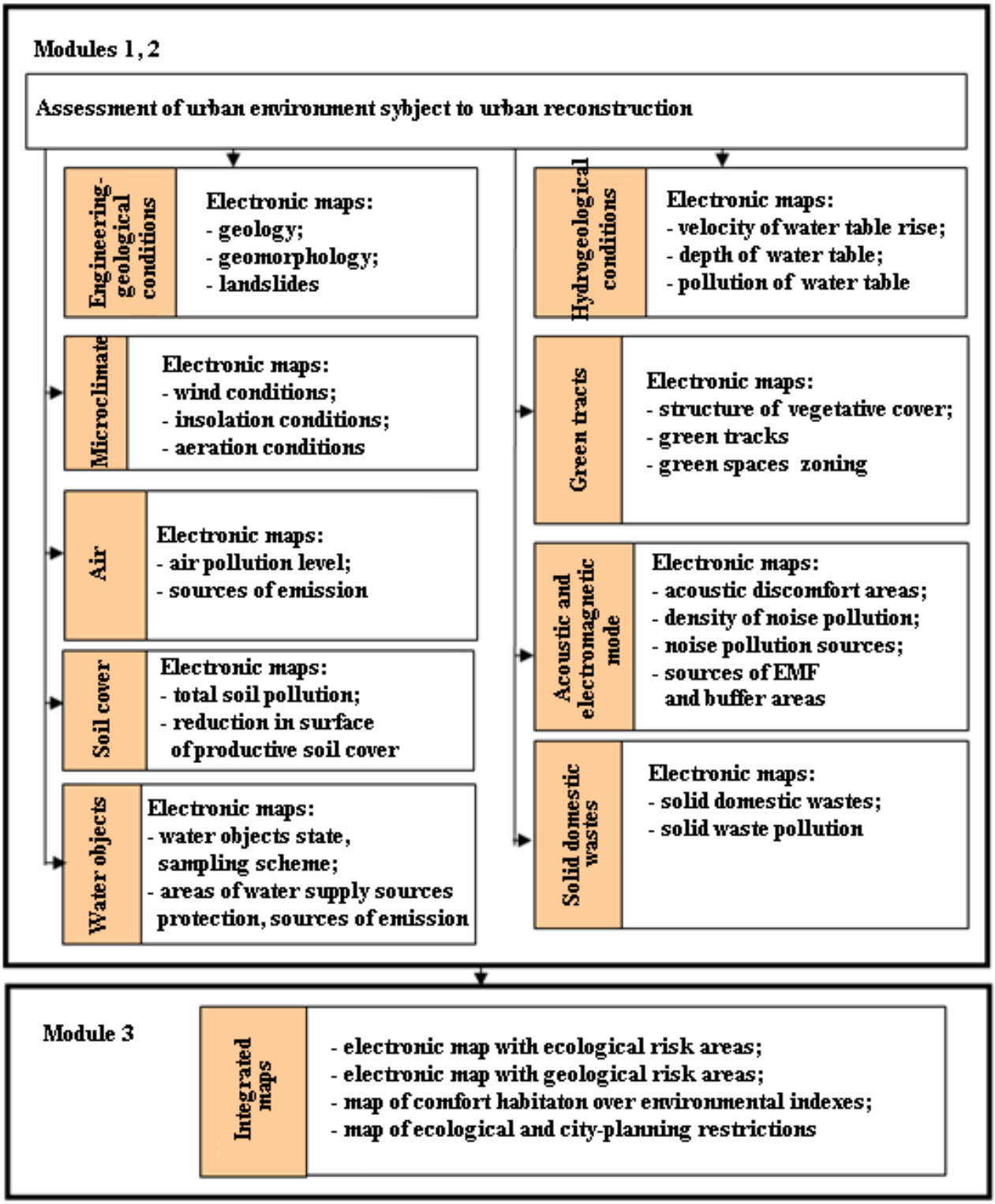

Fig. 2. The complex of urban area indicators of organizational and technological support of urban area reconstruction (modules 1, 2, 3)

Module 6 (data processing module) contains data obtained with the help of system analysis of modules 1—4. It includes information on risk level of negative loads on area of reconstruction, on positive factors of surroundings and anticipated types of destructions.

Thus, it is obvious that development of the system for quality estimation of environment is urgent task. The module of ecological risk management is one of the most important. It should be developed based on complex assessment of urban area by ecological indicators.

The complex assessment of urban agglomeration area is carried out based on analysis of a number of environmental aspects using judgment method.

The electronic maps taking into account indicators of air, soil, water pollution, noise nuisance are used (see Table 1). Suggested classification is based on integrated indicators of environmental pollution and isolation of zones of ecological risk.

Table 1

Classification of ecological indicators with isolation of zones of ecological risk

Ecological risk indicator P_i	Ecological indicators	Zone / point			
		1	5	20	100
		Nonhazardous	Low-hazardous	Hazardous	Abnormally hazardous
P_1	Air pollution indicator	<5	6—7	7—14	>15
P_2	Drinking water pollution (by aberration, %)	<20	20—60	60—80	80—100
P_3	Noise load in the daytime, dB	<64	65—74	75—81	>81
P_4	Water body pollution, (acute toxicity, %)	<1	1—4	4—10	>10
P_5	Soil pollution integrated index (*Zc*)	<16	16—32	32—80	>128
P_6	Solid waste pollution (hazard coefficient of a dump, point)	0-4	4—12	12—16	16—20

Ecological risk is the risk level describing probability of negative effects for a person and environment.

The technology of electronic mapping of the zones of ecological risk in urban area is developed. This technology includes superposition of electronic maps of air, soil pollution, water pollution index, in the medium ArcGIS (see Fig. 3).

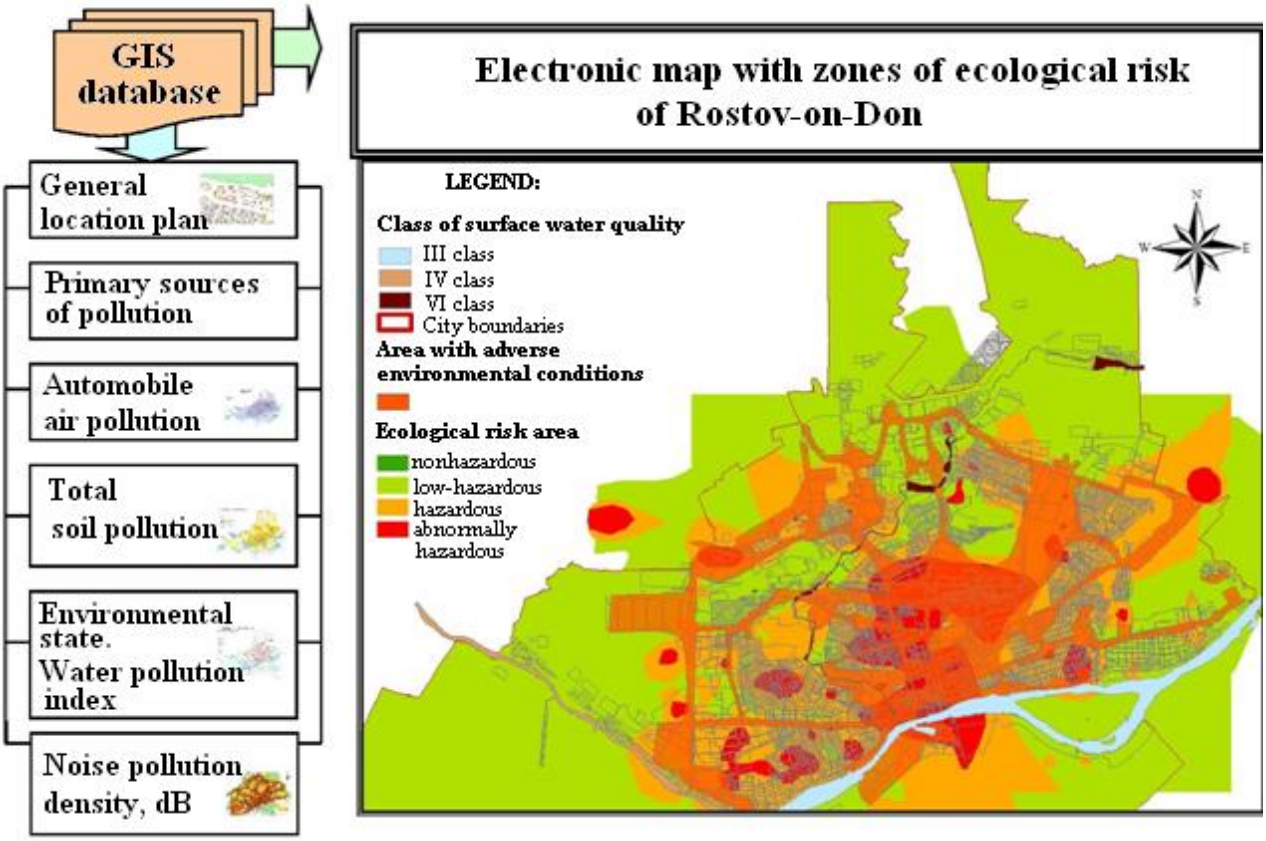

Fig. 3. Electronic map with zones of ecological risk of Rostov-on-Don

The system of organizational, technological, nature-conservative, sanitary, architectural, engineering, planning measures under urban area reconstruction have been worked out on the basis of the results obtained.

Classification of organizational and technological measures on ecological risk management

Organizational and technological measures on ecological risk management can be divided into 2 groups. The first group includes zonal methods, involving big areas (for example, cities), the second group includes local methods, restricted by building area and engineering facilities.

All the nature-conservative measures should be combined into the following groups: town-planning; technological; legal; organizational, economic. Multiple use of methods is the most efficient.

Three groups of methods of ecological risk management are recognized when choosing efficient organizational and technological decision. These groups are retention; decrease and passing of the ecological risk (see Table 2).

Choice of the methods of ecological risk management is determined by risk level. The method of ecological risk decrease is the main method. It should be implemented by investor-developer and requires optimization of ecological justification of time costs and financial viability of organizational and technological decision

Table 2

Types of organizational and technological decision
in different zones of ecological risk

Zone of risk	Types of organizational and technological decision
Nonhazardous (zone of acceptable risk)	Selection of additional organizational and technological measures on ecological risk management is not needed, since negative effect on environment and population health is within established standards under acceptable level of ecological risk
Low-hazard and hazardous zones (zones of acceptable and unacceptable risk)	Development of complex of measures on decrease of risk down to undangerous levels
Abnormally hazardous (zone of forbidden risk)	Passing and decrease of ecological risk with obligatory development of complex of organizational and technological measures

All the organizational and technological measures at reconstruction can be divided into 3 groups:

- elimination of ecological risk factors effects, involving development of measures on air, surface and ground water, and soil protection; urban area protection from noise and electromagnetic fields in a project;
- elimination of origins of the ecological risk factors;
- development of measures on decrease of effect of the source of ecological risks on the environment.

The program module of ecological risk management for information support of urban area reconstruction has been worked out. The module enables one to determine complex of measures for ecological risk decrease when choosing reconstruction site.

Algorithm of measures choice with the use of the program “Ecological risk management” is shown in Fig. 4.

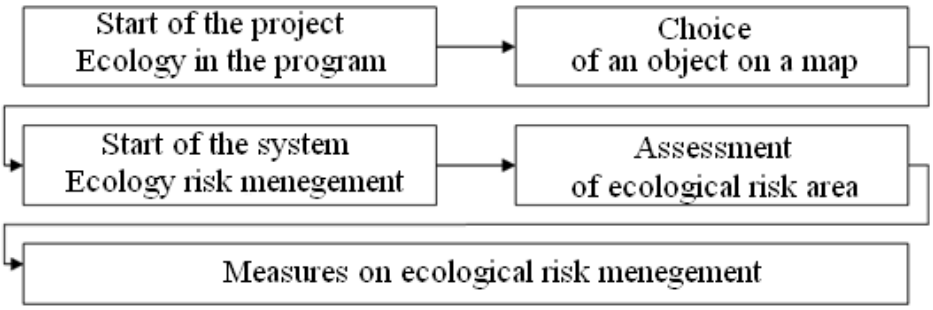

Fig. 4. Algorithm of choice of organizational and technological measures on ecological risk management

The methods of choice of organizational and technological decisions under urban area reconstruction based on the data of environment monitoring are described in informational model of ecological risk management (Fig. 5).

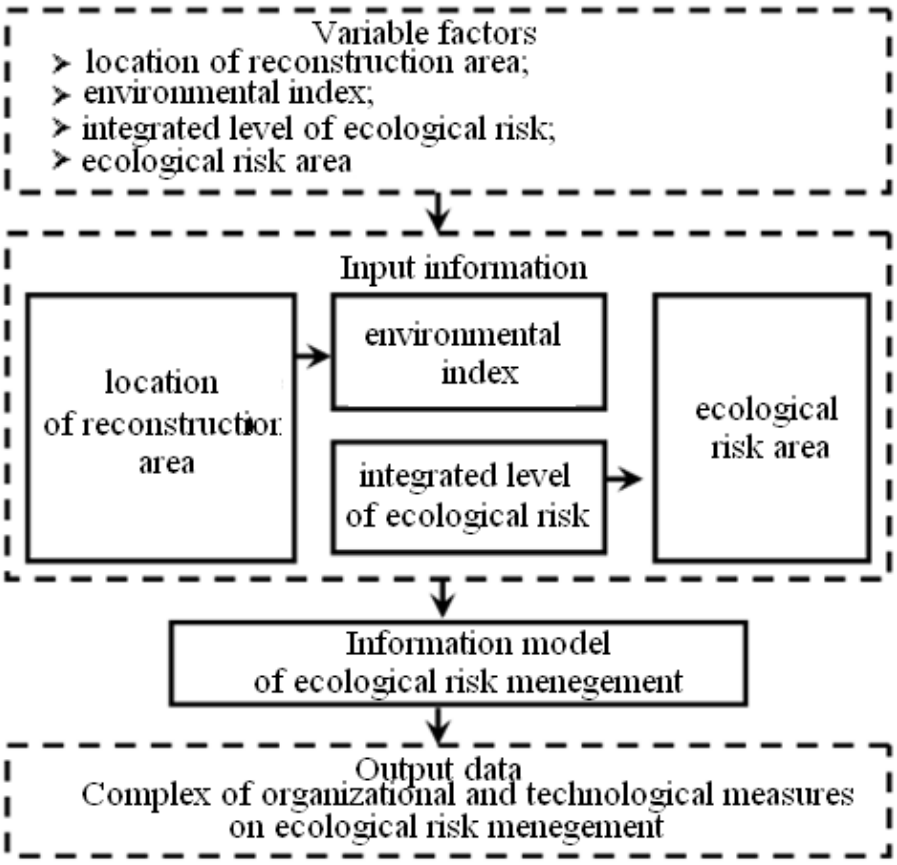

Fig. 5. Informational model of ecological risk management

The algorithm of choice of efficient organizational and technological decisions under urban area reconstruction is suggested in relation to the informational model. The algorithm includes four units. These are unit of location assessment and choice of priority measures (1), unit of choice of risk management method (2), unit of economic justification (3); unit of organizational and technological decision making.

Unit 1 includes:

1. Assessment of environmental indexes using Table 1. Information is taken from modules 1, 2 and specified by the results of ecological surveys.

2. Revelation of impacts and environmental hazards in the area under reconstruction (it is determined in module 4 on the base of analysis of surroundings). These impacts are, for example, total loads increase if there are highways, industrials; escalation of the situation if there are narrow streets, negative effect decrease if there are green tracts, water ecosystems, etc.

3. Determination of integrated index of ecological risk level of urban area depending on urban infrastructure type, which is calculated by the formula

$$U_{эк.р.} = \frac{\sum_{i=1}^{n} b_i \cdot k_{ij}}{n}, \quad (1)$$

where b_i is the point of i index (is determined by Table 1); k_{ij} is the weight coefficient of i index depending on the zone of infrastructure j; n is the number of indexes.

Assessment of environmental impacts of projected economical activity is carried out at different types of project activity depending on particular project. Evaluation of environmental changes after organizational and technological impacts, assessment of objects impacts on environment are carried out. Social and living and economic conditions are also estimated.

If value of basic level of ecological risk is more than value of allowable level of risk, it is necessary to develop the system of organizational and technological measures on its lowering.

Unit 2 includes choice of complex of effective organizational and technological measures, which is developed depending on ecological risk level (see Table 3).

Table 3

Complex on measures on ecological risk management under reconstruction

Integrated index of ecological risk level $U_{эк.р.}$	Zone of ecological risk	Method of ecological risk management	Additional organizational and technological measures
$U_{эк.\ р.}<1$	Nonhazardous	$M_1=M$	Are not required
$1<U_{эк.р.}<5$	Low-hazardous	$M_2=M+M_C$	Additional organizational and technological measures on risk decrease to undangerous level are required

End of Table 3

Integrated index of ecological risk level $U_{эк.р.}$	Zone of ecological risk	Method of ecological risk management	Additional organizational and technological measures
$6<U_{эк.р.}<20$	Hazardous	$M_3=M+M_c+M_П$	Additional organizational and technological measures on risk decrease to undangerous level are required are required; when the level of ecological risk still persists, it is necessary to delegate liability to third parties
$21<U_{эк.р}<100$	Abnormally hazardous	$M_4=M_C+M_П+K$	Ecological risk decrease is requred. measures on compensation for population health damage are carried out. The most appropriate method of management is its transfer using ecological insurance mechanism

Notes on the table: M is the measures on ecological risk retention at normative level; M_C is the measures on ecological risk decrease; $M_П$ is the measures on risk transfer; K is the compensations for health hazard.

The measures on ecological risk management may be complemented by measures on each environmental index.

Unit 3 includes cost estimating for implementation of each measure and determination of ecological risk decrease after this measure implementation. Suggested technology is based upon coefficient of effectiveness when implementing organizational and technological measures on ecological risk decrease in cost estimation form, which is calculated by formula

$$E_{эт} = \frac{U_{пр.т}}{C_m} U_{пр.} \rightarrow \max, \quad (2)$$

where $E_{эт}$ is the coefficient of economic efficiency of m measure; C_m is m measure implementation costs; $U_{пр.т}$ is the averted damage after measure implementation, determined as

$$U_{пр.т} = \sum b_i \cdot k_{iсн}, \quad (3)$$

where $k_{iсн}$ is the coefficient of i-index decrease after m measure implementation.

Thereupon measures are ranked over $E_{эт}$ descending ordering, the most priority measures are selected.

Unit 4 includes calculation of organizational and technological decision averted damage implementation of complex of measures

$$U_{пр.} = \frac{\sum_{i=1}^{n} \Delta b_{ni} \cdot k_{ij}}{n}, \quad (4)$$

where Δb_{ni} is the i-index averted damage, it is determined using (5)

$$\Delta b_{ni} = b_i - b_{im}, \quad (5)$$

wher b_i is the point of i-index before m-measure implementation; b_{im} is the point of of i-index after m-measure implementation.

The possible organizational and technological decision damage is the indicator of efficiency of environmental measures:

$$U_{воз.} = U_{эк.р.} - U_{пр.}, \quad (6)$$

where $U_{пр.}$ is the organizational and technological measures averted; $U_{воз}$ is the possible level of ecological risk.

Conclusion

The optimal organizational and technological decision when choosing environmental measures is the linear combination of maximum and minimum cost of environmental measures for each object and area of reconstruction. This combination make it possible to fulfill the requirements: $U_{воз.}<20$ — for industrial and transport area of infrastructure; $U_{воз.}<5$ — for residential and recreation area and farm areas.

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