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ON METHODOLOGY OF COMPREHENSIVE ASSESSMENT OF ECOLOGICAL STATE OF UFA CITY

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К МЕТОДИКЕ КОМПЛЕКСНОЙ ОЦЕНКИ ЭКОЛОГИЧЕСКОГО СОСТОЯНИЯ ГОРОДА УФЫ

Abstract. In Russia, all the regions are initially considered economically and socially complex systems that develop along the path of a huge set of conditions and processes arising in the internal and external environment. In my opinion, these types of processes should include limitations and resource opportunities, various changes in society, areas of development of the institutional area of the formation of environmental factors, processes and phenomena in the production of non-material, as well as, most importantly, of a material nature. It should be noted that the main and most important basis of the material base studied by me is the economic structure of the regional ecological system of the region, which to a greater extent characterizes stability and its ability to dynamically develop, improve the region as a whole, and its individual territories in particular, through the identification of the input flow and the values and results obtained at the output. It is important to focus attention on the fact that all economic and ecological systems in the process of their development at various stages of evolution are predominantly of the inertial type, which indicates the lack of development of a scientifically based system characterizing these states. In this regard, there are many global issues, both from a scientific point of view and from a practice-oriented direction. Thus, the author in this article examines the issues of methodological analysis and critical criteria explanation of the methodology of comprehensive assessment of the ecological state of the city of Ufa of the Republic of Bashkortostan in its close relationship with economic systems and structures.

Keywords: ecological state of the city, ecological state of Ufa, ecological and economic system of the region, ecological problems.

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Аннотация. Все российские регионы представлены экономически и социально сложными системами, которые проходят свое развитие по пути огромного набора возникающих во внутренней и внешней среде состояний и процессов. К данным типам процессов необходимо отнести ограничения и ресурсные возможности, различные изменения в социуме, области развития институциональной области формирования средовых факторов, процессы и явления на производстве нематериального, а также, что особенно важно, материального характера. Необходимо отметить, что основной и наиболее важной основой, изучаемой мною материальной базы, является экономическая структура региональной экологической системы региона, которая в большей мере характеризует стабильность и ее способность к динамическому развитию, совершенствованию региона в целом, и его отдельных территорий в частности, через выявление входного потока и величин и результатов, полученных на выходе. Важно акцентировать внимание на том, что все экономические и экологические системы в процессе своего развития на различных этапах эволюции носят преимущественно характер инерционного типа, что говорит о недостаточной развитости научно-обоснованной системы характеризующей данные состояния. В связи с этим существует много глобальных вопросов, как с научной точки зрения, так и с практико-ориентированного направления. Рассматриваются вопросы методологического анализа и критического критериологического объяснения методики комплексной оценки экологического состояния города Уфы Республики Башкортостан в ее тесной взаимосвязи с экономическими системами и структурами.

Ключевые слова: экологическое состояние города, экологическое состояние Уфы, эколого-экономическая система региона, экологические проблемы.

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The biggest industrial, scientific and cultural center of the Republic of Bashkortostan is the city of Ufa, which bears the title of the capital of a multi-ethnical sovereign region of the Russian Federation. Also, it should be noted that the territorial unit of the city is a unified ecological social-economic system. The system's functioning and evolution elements contain material criteria of a production nature, including natural ecological resources, and also non-material criteria including the social, the institutional, and of great importance the reputation capital [1, p. 690].

N. Kerimov considers that the model of public consumption in the process of development of a city has formed and stabilized by the start of 21 century [2, p. 39]. The model produces a stimulating impact on exponentially growing of using all the kind of natural resources and uneven increase in production capacities related with a big amount of industrial waste. This behavior leads to the risk of development global ecological problems, which in turn creates a vicious circle of systematical deterioration of natural functioning. I think that the globalization of economic development has reached its highest point at the moment, and the trend of its further development, along with ignoring emerging environmental issues contribute to reducing the safe functioning of the urban territorial structure.

Environmental scientists have found that the human habitat is always accompanied by the development of individual infrastructure specific to this particular region [3, p. 2192]. This infrastructure barely takes into account the peculiarities of natural zones, but adjusts them to its interests and thereby contributes to their destruction. Also, I focus attention on the fact that the interests and needs of humanity are inversely proportional to the features of natural development and categorically contradict each other. So, A. Kochurov cites multiple noises and vibrations excesses in an urban environment [4, p. 186]. I think, in the first turn, this attributes to the consumer attitude to natural resources because people consider nature as a huge storage of material resources and do not consider their destructive impact on it.

According to A. Gorshkova [5, p. 64], the reasons for that controversy are social factors, which directly depend on the level of economic development in a region, and also the general level of education of the population and its ego-ecological self-awareness. This antagonism of the relations arises in the background of conflicts of interests of society and nature, it creates the direction of environmental issues in the region, the degree of their manifestation, and territorial spread. All of this together allows us to reveal and calculate the gradient of the intensity of the ecological situation in each particular region. Because of all of that, I think that the search for a compromise between nature, social and industrial interests is actual. This can bring a solution to a very varied range of regional problems.

One of the main conditions for the stable economic and ecological development of the city of Ufa is effective and rational management of economic development at the level of the city and the region as a whole, which will be aimed at the optimal usage of natural resources under the mandatory condition of maintaining a favorable environmental situation, as well as improving the quality of life of society and the development of the institutional environment [6, p. 153].

It is highly possible to face the problem of choosing priority directions during evaluating categories from the point of view of the economic aspect. Even though the issues of the quality of environment stay on the high level, this leaves a lot of ambiguities in the criteria of the choice for the applied methods of accurate assessment of natural resources and possible economic tensions, that occur in a region in the case of ineffective usage of natural resources and also negative impacts caused increasing in city population and the city expansion in nearby territories.

According to environmentalists, the main problem is in the complexity of evaluating the importance of natural resources in economic criteria [7, p. 597]. This is true because all the conglomerates of the environment ought to be evaluated not only for economic profit but also should be in the area of spiritual-moral and ecological categories of criteria [8, p. 270].

Consequently, there is an urgent need for long-term local influence on changes in the environment, that directly leads to the heald of every individual, to the formation of the phenomena of the variability of ecosystem productivity. And all of this will contribute to the formation of the axiological attitude of society to nature and natural resources.

The relevance of the study is due to the presence of contradictions in the form of the absence of uniform, officially recognized, methodological approaches to assessing the quality of natural resources as a human habitat. The contradictions make it difficult and often almost impossible, to account for natural resources and the quality of a human habitat according to the same value system as the cost of production assets or material values. And on the other hand, there is an urgent need to develop optimal relationships between society and nature [9, p. 264].

S. Morais thinks [10, p. 233] that one of the processes, phenomena, and values evaluation criteria is a determination of the degree of usefulness of the object under study, so in a lot of sources it says that the value of natural resources should be evaluated from the point of their usefulness and human use. It is needed to identify all the benefits that an individual can get by realizing specific natural resources. It also ought to be mentioned, that in the western countries this problem studies quite detailed and it even has formed a new direction in economic science called environmental economic. This discipline considers all the natural values by evaluating them from the point of benefit for people and society. In my paper, I want to focus not on the monetary equivalent of natural resources, but also want to analyze and structure all the useful properties of natural resources.

The list of criteria for assessing the value of natural resources for society is [11, p. 11]:

– resources: the natural resources used directly in the economical and industrial process of society;

– functionals: some fundamental biospheric utilities, as well providing the existence of humanity as a biological species;

– socially significant: these utilities are considered in the sphere of social and cultural community factors and the environment of the existence of the social organization of mankind.

The structure of the nature-ecological landscape plays a big role in the evaluation and sustainability of functioning different systems of economic and ecology [12, p. 3]. The organization of space in the regions has a great significance, for the understanding of which it needs a well-developed and methodologically fixed characteristic of the deployment of these systems. Consequently, in my opinion, such a concept as "economical-ecological landscape" arouses great interest.

Also, to analyze the economical value of natural resources for the point of sustainability of development, it is needed to consider the ability of natural resources to restore, as the most important feature

of the landscape. I believe that the criterion characteristic of this assessment should be carried out according to the scale of natural self-healing, which is correlated and scaled according to a single statistical and analytical parametric system, which ought to be based on generally accepted methods and techniques of standardization of landscape characteristics of natural zones [13, p. 149].

The ecological system, distinguished by the level of administrative-territorial division, is one of the classic objects studied by environmental science. At the same time, such a narrow object of studying, in my opinion, is too insignificant for global system analysis. But in this connection, the study of the biosphere as a whole object is too large a structural unit, which to a greater extent characterizes the unity and hierarchy of the entire ecological system. Thus, studying the particular landscape allows the process the evaluation using system parametric statistical analysis with the highest effectiveness.

Consequently, in the concept of a region, we put not so much the geographical location of the object of research, as a single system of functioning, with clear boundaries, hierarchical structure, certain properties of functioning, and general relationships with the historical and cultural stages of the development of society and the living conditions of the population living in these territories.

Analyzing ecological-economic parameters of an instance of a region allows us to identify a large number of closely interconnected subsystems, structuring of which illustrates high mobility in development and heterogeneity of the evolution of its elements. One of the key objects of the effective functioning of the region is its population, that's the main reason that the study of the peculiarities of its functioning should be performed in close interrelation with a variety of social factors. Regional structural components are in nonlinear dependencies, therefore it allows us to model linear functions, both in a very complex way and at a sufficiently low level. From the point of view of the usefulness of studying and identifying the goals of building various models, it is necessary to identify subsystems, the joint functioning of which would make it possible to assess the dynamics and changes in the development of the region over time to a greater extent [14, p. 698].

It should be noted, that one the current stage of the development of humanity and society, the scales of industrial production activities are exponentially increasing and approaching natural resources in terms of volumes, and often exceed them. In connection with this, an economic cycle has emerged in parallel with the biogeochemical cycle of matter and energy. Recently the growth of anthropogenic and industrial energy flows has been noted on both local and regional levels. The volume of these flows already exceeds the ability of natural resources to self-healing at the moment. Therefore the degree of this exceeding is the base property that affects economic and environmental risks in the development and functioning of the region a lot.

From the technological perspective, it's important to follow the rules of the avoidance combining functioning with the same type of use of resources and thereby avoiding tension and overspending of the same types of natural resources when placing various types of production at the local level.

T. Khachaturov and N. Fedorenko formulated The methodological foundations for maintaining such a balance between implementation and restoration back in 1970. They believe that the main criterion of rational nature management is the economy of future labor, which should follow the principle of minimization of environmental damage during the realization of industrial production activities. This principle also should take into account the effect of self-healing. First of all, using that approach allows the minimization of economic and production costs for the production equivalent in volume to occur with this formula:

$$CP + N + C * E \rightarrow minimum,$$

where: CP is the cost of production; N is the economical evaluation of natural resources and damage to the environment including the deduction of self-healing effect; C is the capital investment of material assets; E is the coefficient of the comparative efficiency of capital investments.

In the second turn, the various range of solutions for environmental and nature-stimulating measures, where the result of measures is the increase in the economic assessment of natural resources, should be compared regarding the maximization of the effect using the formula:

$$R - C * E \rightarrow maximum, \text{ where: R is the result of measures.}$$

In case of the equality of both economic and production costs for the production and the same level of the effect of environmental and nature-stimulating measures, the optimal solution should be found using the method of minimalization fixed assets turnover ratio upon the limited amount of capital investments and the maximum amount of workforce productivity with limited labor resources [15, p. 317].

I believe, in such a case the main factors are sustainability and quality of economic and environmental infrastructure. In my opinion, this meaning is a system of natural-territorial formations, involved in ensuring the turnover of matter and energy and consisting of many such indicators as forest cover of the territory, characteristics of the soil and its biogeocenosis, types of land use, quantitative features of the population, productivity and types of economic activity, as well as temperature and other environmental factors.

It is extremely important to apply the systematic approach during analyzing the state of economic and environmental infrastructure. One of its features is the approach allows estimating the optimal states of the infrastructure for every territorial system and also to calculate the most optimal indices, which grow during the integration and transition from one system to another, providing a high level of vertical balance.

Environmentalists believe that the basic principles of environmental management regulation should be studied in two key aspects – socio-economic and environmental. This is primarily since when using and realizing natural resources by one of the participants in the process, the interests of others are inevitably affected, therefore, the issues of meeting the needs of one nature user cannot be considered in isolation from the interests of others, regardless of the level of consumption and the quality of the resource composition of this territory. It is also necessary to correlate these interests taking into account the long-term prospects for their development and coexistence [16, p. 47].

The socio-economic principle provides for an even distribution of natural resources among all nature users within the region. I believe that the initial conditions for the use of resources should be equal, but the economic interests of all regional economic entities should also be respected.

The ecological principle, in turn, implies mandatory compliance and consideration of regulations and standards for resource consumption, which help to regulate and maintain the integrity and sustainable functioning of all types of ecosystems, by ensuring the preservation of the current state of the ecosystem or improving it to the maximum possible level. This is especially important concerning the regulation of consumption and use of water resources.

It should be noted that the production conditions on the territory of reservoirs assume certain stability of the intake of chemicals, including macro and microelements, into the environment (human water consumption, wastewater discharge, release of pollutants into the atmosphere, the use of fertilizers, and plant protection products). Many authors argue that the level of real anthropogenic load on the ecological state of aquatic ecosystems cannot change dramatically and significantly over a short time interval, since these processes and phenomena have a certain inertial capacity, which can affect the normative quality of

water. Thus, the establishment of standards for the permissible anthropogenic load on the aquatic ecosystem has a probabilistic characteristic. It is possible to specify the level of load that will help ensure a certain quality of water resources, but at the same time, there is a possibility of situations when the normative water quality cannot be fully realized, no matter how much anthropogenic impact is limited.

Based on the above, it can be concluded that the normative value of the permissible load on the aquatic ecosystem of the region, including the city of Ufa, can be determined by two interrelated criteria: firstly, it is a given level of the required quality of water resources, and secondly, the probability of its improvement and stabilization at a fairly good level [17, p. 135].

Therefore, this probability is mainly determined by social (population, labor factor, standard of living) and economic (production infrastructure, income, taxes, investments, etc.) factors, and not by the peculiarities of the formation of water and chemical runoff from reservoirs and catchments. In the conditions of the country and the region, concerning the aquatic ecosystem, a huge number of problems and negative phenomena have accumulated: there is an active increase in the irrational use of water resources, at the same time, water quality remains at a fairly low level, the risk of an environmental catastrophe increases every year due to pollution of river basins, and in the conditions of global pollution of the biosphere, there is no uniform international regulation of permissible harmful effects on water bodies. At the same time, there is a reduction in funding for scientific research in the field of ecology of the aquatic environment and nature management, and, accordingly, there is a decrease in the share of scientifically and innovative approaches to water use. There is a complete lack of social responsibility of the population in water use, there is no unified information base that summarizes and coordinates the actions of various entities in the use of water resources.

In the modern world, the combination of these negative factors and phenomena, as well as the imperfection of the environmental management system, is characterized by fragmentation and uncontrollability. This sphere is regulated only at the level of production funds of the federal executive. A characteristic feature of such management is extremely low efficiency and senseless duplication of activities. Since the territories of catchment areas and reservoirs of small rivers are part of one basin of a larger river, that is, they are a relative part of a single system, it is advisable to calculate their relative, ranked indicators, which will allow more effectively differentiating different sections of the basin by relative economic and environmental risk.

Displaying the information obtained in this way on the map, with its superimposition on the state of water management balances in various areas, allows us to visually and effectively assess the level of tension and optimal modes of functioning, both in the real state of the water management system and when using mathematical and statistical modeling of various environmental processes and situations. Thus, economic and environmental risk (EER) is a functional interaction of three states of the system: impact, response (sustainable efficiency), and productivity. At the same time, the degree of impact definitely increases the risk of system destruction, while the stability of the system absorbs the environment, and productivity compensates for the economic component of the risk [18, p. 39].

As a result of the analysis of the methodological literature, I concluded that the basis for solving risk management problems is often the need to develop optimal modes of functioning of the system, taking into account the degree of destabilization of its ecological state. Therefore, for increasing the efficiency of such management is crucial to study not so much the quantitative as the qualitative state of the system. At the same time, the qualitative analysis of the data obtained, as well as their further synthesis into a single whole

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system, is usually reduced to their ranking by certain criteria, while the corresponding factor analysis allows you to pair these data with the semantic characteristic of their states, which is set by special qualitative variables. Such variables combine quantitative expressions in the form of fuzzy descriptions, for example, "tense situation", "satisfactory situation", etc [19, p. 14].

Summarizing the above, the assessment of the ecological and economic situation of the city of Ufa should be carried out in stages, with the solution of a certain task at each stage, and the results of solving the tasks of one stage will be the basis for solving the tasks of all subsequent stages forming a shape of pyramid [20; p. 81]. Guided by this, I identified the following stages of the research program implementation:

Stage 1. Multidimensional analysis and study of indicators reflecting the main aspects of the work of the natural and economic system and the allocation of the main representative parameters (parametric statistics).

Stage 2. Variational analysis of the identified parameters aimed at studying the structure of their distribution, the frequency of exceeding the specified criteria, which will later be used to calculate the risks of destabilization of the ecosystem of the region and to determine the qualitative determination of the frequency density values exceeding the normalization.

Stage 3. Factor analysis and interpretation of the obtained quantitative and qualitative characteristics of the environmental situation in the city of Ufa.

Thus, as a result of my research, I substantiated the concept of ecological and economic development, as well as formulated the principles of territorial assessment of the city of Ufa in complex spatially distributed systems. Determined that economic and environmental risk (EER) is a function of three states of the system: impact, response, and productivity. At the same time, the degree of anthropogenic impact significantly increases the risk of destabilization of the system, the stability of the system absorbs the environment, and productivity compensates for the economic component of the risk.

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