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Assessment of Environmental Parameters Impact on the Level of Sustainable Development of Territories

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Abstract

The reason for the research is Russia's transition to the model of sustainable development. The environmental component plays the important role in the formation of sustainable development of the territories. This research area enables to estimate the influence of environmental parameters on the level of sustainable development of territories. Indicators characterizing the state of the environment and ecological potential of these territories were used as indicators which have an impact on sustainable development. This research was carried out on the basis of multiple regressions method. For the first time the classification of regions of the Russian Federation for 2013 by the level of environmental safety was made. As a result, the most significant indicators affecting the sustainable development of territories were revealed and decisions for the management of these parameters were developed in order to improve the sustainable development of territories.

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1. Introduction

The assessment of the impact of environmental parameters on the sustainable development level of territories has paramount importance. This is due to the processes of urbanization: atmospheric air pollution, deterioration of living conditions in regions, pollution of the environment around industrial centers, etc. Therefore, this research has a high degree of scientific and practical significance since it implies the development of methods of assessment of the environmental parameters impact on sustainable development of regions. This method enables not only to identify key environmental parameters, to evaluate their impact on the sustainability of territories, but also to classify them according to the environmental safety level. These results can be used to develop management solutions to ensure the sustainable development of territories taking environmental parameters into account.

The novelty of the research is as follows:

1) The method for the formation of indicators characterizing the ecological safety of territories on the basis of the main factors is developed;

2) The regression model of the correlation between the sustainable development of the territory and environmental safety factors enabled to reveal environmental safety factors which have the greatest influence on shaping the sustainability of the system;

3) For the first time the classification of regions of the Russian Federation for 2013 by the level of environmental safety was made through the use of typological groups method and cluster analysis with the determination of stable groups.

2. Critical review of the materials on the research topic

Since the 20th century in response to the challenges of globalization, international centers, such as the World Bank, the Organization for Economic Cooperation and Development (OECD), the United Nations, Institute for Sustainable Manufacturing, V.B. Sochava Institute of Geography, Russian Academy of Sciences Center for Ecological Safety and others

developed and offered solutions in the sphere of sustainable development of territories. One of the common methods of the assessment of the sustainability of a territory with regard for environmental parameters is the use of the integrated assessment. It boils down to the reasonable selection of the most informative indicators, the choice of the type and rules of standardization of these indicators, the choice of the form of calculation of the integral indicator. [1]

The World Wildlife Fund (WWF) designed the Living Planet Index. It is based on the estimates of the population size of particular wild species and is calculated for forest, marine and freshwater ecosystems. Besides, WWF developed such indicator as the Ecological Footprint, which measures the pressure on the environment by any person, enterprise, organization, community, country, the population of the entire country.

Yale and Columbia Universities in the United States developed the index of environmental sustainability. This index implies the use of 76 indicators in the calculation grouped into 21 indicators, which are reduced to five components: "ecological system", "reduce of environmental stress," "reduce of the vulnerability of humanity", "social and institutional capacities", "global oversight." [2].

The United Nations developed a system of indicators of the Millennium Development Goals which is aimed to assess the effectiveness of actions to address social problems and human capacity development in the developed countries. Among the objectives of the MDG is the environmental goal, which is aimed to ensure the environmental sustainability of the planet.[3]

Moscow State University under the guidance of I. N. Rubanova, V.S. Tikunova developed an integrated assessment of the ecological state of the environment of regions of the Russian Federation. This assessment involves getting an integral composite index of ecological state of the environment and the ecological state of the individual indices of its components, which take a value on the scale from 0 to 100. [4]

S. N. Bobylev, V. S. Minakov, S.V. Solovyova and V. V. Tretyakov proposed the ecological and economic index of the Russian Federation regions. The development of the integral index was based on the principles of Adjusted net saving index construction. The developed integral estimate considers environmental sustainability in a broad context, including environmental, economic and social factors into account.[5, 6]

The critical analysis of methods of the assessment of environmental parameters impact on the economy has revealed a shortcoming of such research. These works do not study the interconnections between environmental parameters and the sustainable development of territories. To solve the identified problem, factors of environmental safety are proposed to be considered as environmental parameters. By the environmental safety we will mean the state of protection of the environment and the vital interests of a person from the possible negative impact of economic and other activities, from natural and anthropogenic disasters and their consequences. [7]

3. Methodology of the research

Environmental safety is a complex multidimensional phenomenon. By the environmental safety we will understand the qualitative characteristics of social and economic development, which involves the formation of a new type of technological processes, social organization, management etc., which can efficiently solve environmental problems and protect the society and the person from any environmental dangers (emissions of harmful substances, resources shortages, natural disasters, accidents etc.).

This definition of the environmental safety was formulated by N. Vashchekin. [8].

The level of ecological safety directly affects the state of economic development of the system. It is due to the fact that economic development has a negative impact on the environment. Therefore, in our study we used economic indicators reflecting the use of advanced technologies that can help to reduce the load on the environment (reduction of material costs per unit of goods, work and services by organizations, as a percentage of the total; reduction of energy to produce a unit of goods, work and services by organizations, as a percentage of the total; reduction of carbon dioxide emissions (CO₂) by organizations, as a percentage of the total). [9, 10, 11]. In addition, the regression equation for 2013 was made for assessing the impact of environmental factors on the level of sustainable development.

This research is based on the data already used in our previous work [12, 13, 14], but the object of study and the methods are different.

This work considers the developed author's method of assessment of the impact of environmental parameters on the level of sustainable development of territories with the use of multivariate statistical analysis - factor analysis, regression analysis, method of multidimensional average, method of typological groups, index method.

Multivariate statistics techniques enable to establish a quantitative relationship between the studied phenomena (correlation analysis), to investigate the relationship between the variables (regression analysis), to identify the role of individual factors in the change of the analyzed parameter (factor analysis) etc.

The use of the multidimensional average and the method of typological groups ensure the correctness of the results of the conducted research. This is due to the fact that the object under study is heterogeneous and requires prior typology.

These methods has not only strong but also weak aspects. A big amount of original data is required to ensure the credibility of results of a research, and the use of statistic methods is practically impossible without a computer.

Figure 1 shows the methodology of the study.

On the first stage a metrics is formed. It is the key stage of the work because the result of research depends on the correct selection of the original data set.

Therefore, the set of indicators is selected on the basis of credibility, self-descriptiveness, reliability, comparability and quality of information. For matching these criteria the original data set is proposed to be made on the basis of the data of the Federal State Statistics Service. [15]

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