Advances in Economics, Business and Management Research, volume 208
Proceedings of the International Scientific and Practical Conference Strategy of Development of Regional Ecosystems "Education-Science-Industry" (ISPCR 2021)

Approaches to Assessing Sustainable Development of Territories and Features of Their Application

Aleksey A. Malyshev [1][ORCID 0000-0002-1956-6712],
Natalia A. Korobkova [2][ORCID 0000-0003-2682-1504],
Tatyana V. Kudryashova [3*][ORCID 0000-0003-4056-3855]

[1] *Penza State Technological University, Penza, Russia*
[2] *Penza State University of Architecture and Construction, Penza, Russia*
[3] *Yaroslav-the-Wise Novgorod State University, Veliky Novgorod, Russia*
Tatyana.Kudryashova@novsu.ru

ABSTRACT
The article presents an analysis of approaches to the content of the concept of sustainable development and methods for its assessment. The relevance of the research topic is justified by the trends of the spread of a green economy. These trends have been formed, among other things, taking into account the Sustainable Development Goals adopted by the United Nations (UN). Achieving these goals has been identified as a key idea of public administration in many countries. However, in practice, the shift towards a green economy has provoked the emergence of an energy crisis. Under the current conditions, it is important to understand the concept of sustainable development and create an adequate methodology for its assessment. The purpose of the presented study is to examine approaches to assessing sustainable development and testing the proposed methodology for its assessment on the example of a particular region for the period 2010-2019. The study substantiates the allocation of such elements of sustainable development as economic, social, and environmental sustainability; the factors and indicators that determine them have been analyzed. A brief description of the existing methods for assessing sustainable development is presented. The expediency of creating a methodology for assessing sustainable development, not overloaded with indicators, has been proved. Indicators for assessing seventeen basic blocks in the context of the UN Sustainable Development Goals have been formed and justified. The application of the method of standard deviations is proposed. The difference of this method is the use of the best indicators for the assessment period as base values. It appears that such an approach will make it possible to level the differences in the assessed socio-ecological systems. The results obtained have made it possible to identify problem areas in the sustainable development of the region under study, to visualize and characterize the directions of its development. The findings of the study can be used as an information base in the development of programs for the socio-economic development of the territory.

Keywords: *sustainable development, sustainability, socio-ecological and economic development, Sustainable Development Goals*

1. INTRODUCTION

During 2021, especially in recent months, many world powers are subject to an energy crisis caused by high growth rates in hydrocarbon prices, while its deficit. The situation is especially difficult in China, where in the summer and autumn of 2021 there were repeated power outages, as a result of which not only the citizens of the country suffered but also many enterprises were forced to suspend their work. As a result, the Goldman Sachs investment banking firm cut its forecast for China's economic growth by 0.4%. Now it is expected at 7.8%. Many economists attribute the decline to the shift towards a green economy. Back in 2008, the leadership of the PRC prioritized the concept of ecological civilization as the country's leading development strategy. The key idea of this concept is the introduction of clean energy, primarily solar, and innovative green technologies.

A number of countries and regions of the world, including the European Union, have stated that it is best to take into account environmental measures, as well as climate impact measures, in order to restore the economy after the pandemic and restrictive measures. The process of restoration should be as environmentally friendly and low-carbon as possible. In the ideal case, it is necessary to correlate the issues of economic restoration with the issues of further decarbonization and greening of the industrial, transport, and other sectors of the economy. In addition to the European Union, South Korea and other countries announced a similar intention. A number of countries announced their intention to become carbon-neutral by the middle of the century, Japan and South Korea – by 2050, China – by 2060. The Paris Agreement [1] also indicates the countries' goal of full carbon neutrality and complete decarbonization by 2050. In these circumstances, the problem of the formation of sustainable development becomes more and more urgent.

The starting point of worldwide attention to sustainable development was the 1987 Brundtland Report which helped to define it as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" [2]. Achieving the Sustainable Development Goals (hereinafter SDGs) has been identified by UN member countries as a key idea of public administration. It appears that the achievement of these goals is impossible without the formation of a methodological base for their assessment.

In the scientific literature, there are many methods for assessing the balance of sustainable development. Thus, the system of indicators proposed by the United Nations (UN) has 17 interrelated SDGs and 169 corresponding indicators. However, the International Council for Science (ICSU) expressed concern about the compatibility of these indicators, in particular, about the incompatibility of socio-economic development and environmental sustainability. In addition, each country, and in some cases a separate region, has limitations imposed by social problems, technological progress, and environmental factors. Consequently, each country needs to develop its policies and standards, taking into account the global SDGs [3].

It is reasonable to assume that the differences in existing methodologies are largely related to the understanding of the essence of sustainable development. According to R. Axelsson et al. [4], sustainable development is rather a collective social process involving several concerned parties with different levels of authority. It is a multidimensional integrated concept in its scope [5]. Sustainable development also helps to strike a balance between preserving ecosystems and addressing human needs. The three pillars of sustainable development are environmental, social, and economic sustainability, and these structures should be consistent.

Environmental sustainability is connected to limiting human activities within the carrying capacity of the ecosystem (e.g. materials, energy, land, water, etc.) prevailing in the area, and focuses on the quality of human life (air quality, human health). Economic sustainability refers to the efficient use of resources to increase operating profits and market values of companies. While social sustainability focuses on the social well-being of the population, balancing the needs of an individual with the needs of society.

A number of studies state that the protection of environmental factors and ecosystem services, as well as economic and social development, are crucial determinants of sustainable development [6]. A.D. Basiago [7] proposes to use economic, social, and environmental sustainability as indicators of sustainable development. F. Guijarro and J.A. Poyatos [8] point out that sustainable development includes income inequality, environmental sustainability, innovation, equity and sustainable consumption of available resources. J. Sathaye et al. [9] argue that environmental and economic aspects are the main determinants of sustainable development. In addition, a number of studies state that economic growth and economic development directly depend on the environment and the conservation of natural resources in the country [10]. M. Howes et al. [11], Y. Dong and M.Z. Hauschild [12] identify factors of environmental sustainability that are also strongly associated with sustainable development. S. Sala et al. [13] consider sustainability assessment as a method for assessing the level of implementation of measures to ensure sustainability.

Since the early 1990s policymakers have developed and are using a range of criteria for sustainability and sustainable development. Indicators of output such as GDP, net domestic product, and real per capita consumption are widely used, but they reflect only the economic aspect of development [14] and can be misleading because they do not take into account the overexploitation of natural resources. This has led to the emergence of a number of studies that consider the depletion of the

ecological or natural population. For example, the true economy index [15], the ecological footprint [16], the environmental sustainability index [15].

Thus, ambiguities, errors, and biases in data collection and analysis of sustainable development measures imply that there are no indicators that would be universally accepted by policymakers [17]. An additional problem is the lack of an indicator that can be easily compared and interpreted across countries and sectors.

It appears that sustainable development is a concept that is theoretical and cannot be directly measured and assessed. Accordingly, since the direct measurement is not possible, it can be replaced by sets of indicators. However, the UN sustainable development model, which consists of 169 indicators, seems to be overloaded.

A different position is taken by researchers who propose to measure sustainable development on the basis of a single indicator. This indicator can be the level of employment, the dynamics of GDP or GRP [18, 19]. This approach eliminates the need to aggregate multiple indicators but does not provide a complete picture of sustainable development assessment.

With an alternative approach, it becomes necessary to reduce the set of private indicators to a single index. To do this, scientists use the following methods: the use of arithmetic or geometric mean indices, the product of reciprocal indicators [20], entropy indicators [21], resistance index [22], the Mahalanobis distance method [23].

This article presents an overview of existing approaches to assessing sustainable development and reflects the features of their application. A critical analysis of existing methods has made it possible to form an approach to assessing the dynamics of sustainable development in the context of Russian regions. It is based on the system of national SDG indicators. Testing of methods was carried out on the example of Penza Oblast.

2. MATERIALS AND METHODS

The purpose of this study is to develop and test a methodology for assessing the sustainable development of a territory on the example of a particular region based on the study of approaches to such an assessment existing in world practice.

This goal predetermined the need to solve the following tasks:

- conducting a critical analysis of existing methods for assessing sustainable development;
- selection of relevant indicators of sustainable development of the territory, corresponding to each goal of sustainable development proposed by the UN;
- development and description of the methodology for calculating the integral indicators of the stability of the territory;
- testing of the developed methodology for assessing the sustainable development of a particular territory based on data from the official state statistics service.

Any assessment of sustainable development is based on a group of indicators for each of the elements, namely economic, social, and environmental sustainability. The ratio of these elements is often determined in Russian studies on the basis of establishing weighting factors, while in foreign works, their equality is recognized for the overall assessment [24].

In this study, the authors adhere to the principle of equal value of the basic components of sustainable development, which is reflected in the UN methodology. Accordingly, the assessment methodology proposed by the authors does not contain weighting factors for economic, environmental, and social sustainability. It appears that it is possible to select an indicator that best reflects the sustainable development of a region for each SDG proposed by the UN. This approach was applied in the work of V. Spaiser et al. [20]. The factor analysis of the influence of each indicator on the value of sustainable development carried out by the researchers helped to choose the most significant ones for each type of sustainability. Based on the results of their research on some countries of the world in the period 1980-2014, the authors of the current study have selected 17 indicators (*Table 1*).

When selecting indicators, we proceeded from the following principles: firstly, the indicator should reflect a goal of sustainable development and be significant according to the factor analysis results; secondly, it should be calculated by the statistical authorities annually in the context of the constituent entities of the Russian Federation.

It appears that comparison with others is advisable when assessing similar entities, however, in the context of the regions of the Russian Federation, this method is not always justified. By

analogy with the study of E.A. Tretyakova et al. [25], we use the standardized value of deviations in the current study, only not relative to other regions, but relative to the best value in the region for the period.

Table 1. Indicators for assessing the sustainable development of a region, taking into account the SDGs

No.	SDG According to the UN Methodology	Assessment Element	Assessment Indicator for a Region
1	Complete poverty eradication in all its forms	Economic sustainability	Percentage of population living below the national poverty line for the year preceding the previous one, %
2	Hunger eradication, ensuring food security, and improving nutrition, supporting sustainable agricultural development	Economic sustainability	Consumption of meat and meat products, milk and dairy products per capita, kg per year
3	Ensuring healthy living standards and well-being support for all at all ages	Economic sustainability	Mortality of children aged 0-4 years per 1000 live births
4	Ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all	Social sustainability	Number of students enrolled in training programs for future qualified workers, employees, per 10000 people of the population
5	Ensuring gender equality and empowering all women and girls	Social sustainability	The employment rate among women, %
6	Ensuring the availability and rational use of water resources and sanitation for all	Environmental sustainability	The volume of recycled and consistently used water, million cubic meters
7	Ensuring access to affordable, reliable, sustainable, and modern energy sources for all	Environmental sustainability	GRP energy consumption, kg of fuel equivalent/10 thousand rubles, in constant 2012 prices
8	Promoting sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all	Social sustainability	Employment rate, %
9	Building resilient infrastructure, promoting inclusive and sustainable industrialization and innovation	Economic sustainability	Public roads density, km of roads per 1,000 square kilometers of the territory
10	Reducing inequality within and between countries	Social sustainability	The Ginny coefficient
11	Ensuring openness, safety, resilience, and environmental sustainability of cities and human settlements	Environmental sustainability	Share of green space within the city limits to the total area of urban land within the city limits, %
12	Ensuring the transition to rational models of consumption and production	Environmental sustainability	Expenses for environmental protection, at then-current prices, million rubles
13	Taking urgent measures to combat climate change and its consequences	Environmental sustainability	The share of collected and neutralized pollutants in the atmosphere in the total amount of waste pollutants from stationary sources, %
14	Preservation and rational use of oceans, seas, and marine resources for sustainable development	Environmental sustainability	Discharge of polluted wastewater into surface water bodies, million cubic meters
15	Protection and restoration of terrestrial ecosystems and promotion of their sustainable use, sustainable forest management, combating desertification, halting and reversing land degradation, and halting biodiversity loss	Environmental sustainability	Reforestation, thousand hectares
16	Promoting a peaceful and inclusive society for sustainable development, ensuring access to justice for all, and building effective, accountable, and inclusive institutions at all levels	Social sustainability	Reported crimes per 100,000 people of the population
17	Strengthening the means of implementation and revitalizing the global partnership for sustainable development	Economic sustainability	Volume index of the GRP per capita, %

Source: Compiled by the authors

To assess the indicators, it is necessary to standardize the actual values of the indicators in relation to the best-achieved value for the entire observation period for a particular region. At the same time, the standardization of indicators, the increase in the value of which positively affects the sustainable development of the region, is carried out according to the formula (1), the standardization of indicators, the increase in the value of which negatively affects the sustainable development of the region, is carried out according to the formula (2):

$$X_{Si} = \frac{x_i}{\max x_i} \quad (1)$$

$$X_{Si} = \frac{\min x_i}{x_i} \quad (2)$$

where X_{Si} – the standardized value of the i-th indicator; Xi – the actual value of the i-th indicator.

Standardized values are in the range [0; 1] and determine the proximity of the real value of the indicator under study to the best value for the period under evaluation. The closer this value is to 1, the higher the result achieved by it in comparison with the reference one.

The final value of sustainability for the year is calculated by the formula (3):

$$S = \prod_{i=1}^{n} X_i \quad (3)$$

Using this formula, you can separately calculate the values in the context of economic, social, and environmental sustainability. Their values, as well as the integrated indicator of sustainable development, will be in the range [0; 1]. The closer the value is to 1, the better the stability performance.

3. RESULTS

To calculate the sustainability values and assess the integrated indicator of sustainable development, data from the website of the official state statistics service were used.

As a result of assessing the stability values for a specific region of the Russian Federation (Penza Oblast), the values have been obtained, which are presented in *Figure 1*.

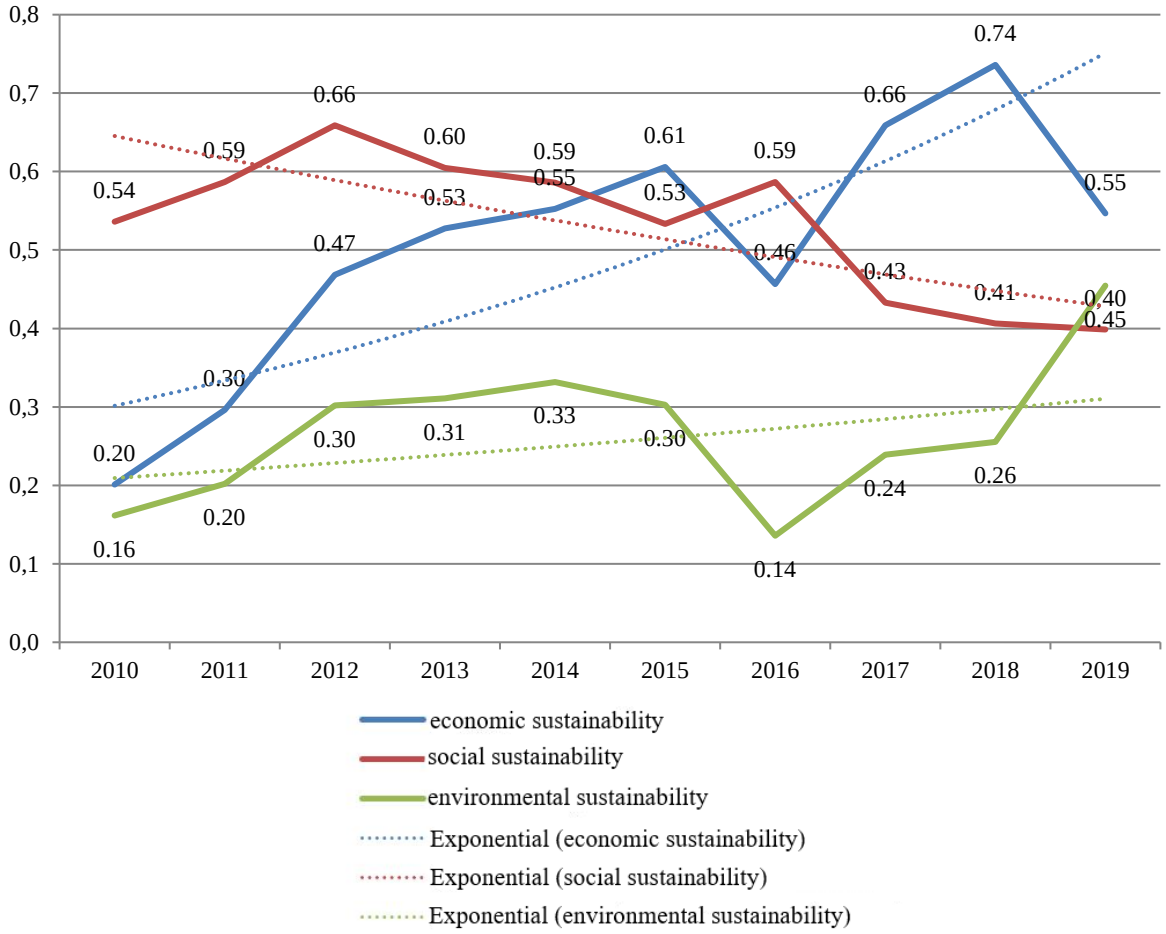

Figure 1. Calculated values of sustainable development of Penza Oblast by components
Source: Compiled by the authors

The analysis of the data obtained indicates the multidirectional nature of the dynamics of the elements of sustainable development. Thus, the dynamics of economic stability have, in general, an upward trend, however, a decrease in values in 2016 is noted. One of the reasons for the decline is a decrease in the GDP growth rate, especially in post-crisis 2015. The social sustainability has a pronounced downward trend, and the largest decline in the social sphere can be noted in the period 2017-2019. It was caused by a decrease in employment and an increase in the Gini coefficient. In the figure, the positive change in the value of environmental sustainability, caused by increased environmental

spending and reduced wastewater discharges, is evident.

The integrated indicator of sustainable development is presented in *Figure 2*.

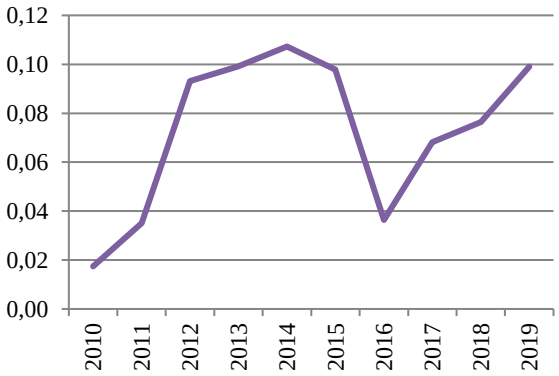

Figure 2. Dynamics of the integrated indicator of sustainable development of Penza Oblast in the period 2010-2019

Source: Compiled by the authors

The dynamics of the indicator demonstrate the maximum value of stability in 2014, after which the maximum decline followed.

4. DISCUSSION

The methodology proposed in the current study is not universal, it is aimed at assessing the dynamics of sustainable development indicators over a certain period of time. Its feature is the possibility of carrying out the calculation using the data of one region or some territory. Most researchers use a complex methodology to assess sustainable development, which involves comparison with other subjects [22, 23, 25].

However, for decision-making at the level of regional authorities, a comparison of values with previous periods seems more appropriate. It will allow you to quickly identify negative trends that are emerging in the context of economic, social, or environmental sustainability.

According to this methodology, ensuring sustainable development will be facilitated by the increment of positive values of the dynamics over a long period.

The study showed generally positive trends in the sustainable development of Penza Oblast. The most problematic is social stability, the values of which have a negative trend. The testing confirms the practical significance of the proposed methodology.

5. CONCLUSION

The study has analyzed sustainable development as an object of assessment. It has identified three key elements in the context in which the assessment is carried out. The characterization of the existing methods for assessing sustainable development has made it possible to find the main obstacle in their application which is the complexity of the methodology and the use of a large number of indicators. As an alternative method, an assessment has been proposed, based on 17 indicators in accordance with the UN SDGs. The testing of the method on the example of assessing the dynamics of sustainable development of Penza Oblast in the period 2010-2019 has confirmed its practical importance.

AUTHORS' CONTRIBUTIONS

Aleksey A. Malyshev – research problem statement; scientific guidance; formulation of the main study concept; critical analysis and finalizing of the text. Natalia A. Korobkova – preparation of the text of the article; literature review on the problem under study, preparation of graphic results of the study; formulation of conclusions; development of recommendations. Tatyana V. Kudryashova – addition of the research problem; critical analysis; formulation of conclusions; editing of the text of the article.

ACKNOWLEDGMENTS

The research was carried out with the financial support of the Russian Foundation for Basic Research (grant no. 20-010-00875 A).

REFERENCES

[1] "Climate Action. The Paris Agreement", 2015. United Nations. Retrieved from https://www.un.org/en/climatechange/paris-agreement

[2] Y.N. Lee, "Goldman cuts China's growth forecasts, citing power crunch as 'yet another growth shock'", 2021. Science Metro. Retrieved from https://www.cnbc.com/2021/09/28/goldman-sachs-cuts-chinas-gdp-growth-forecasts-amid-energy-crunch.html

[3] "Report of the World Commission on Environment and Development: Our common

future", Oxford University Press, New York, 1987. Retrieved from http://www.un-documents.net/our-common-future.pdf

[4] R. Axelsson, P. Angelstam, M. Elbakidze, N. Stryamets, K.-E. Johansson, "Sustainable development and sustainability: landscape approach as a practical interpretation of principles and implementation concepts", Journal of Landscape Ecology, 2011, vol. 4(3), pp. 5-30. DOI: 10.2478/v10285-012-0040-1

[5] M. Slimane, "Role and relationship between leadership and sustainable development to release social, human, and cultural dimension", Procedia – Social and Behavioral Sciences, 2012, vol. 41, pp. 92-99. DOI: http://dx.doi.org/10.1016/j.sbspro.2012.04.013

[6] Y. Qu, M. Li, L. Quin, "Environmental practice and its effect on the sustainable development of eco-industrial parks in China", International Journal of Sustainable Development and Planning, 2015, vol. 10(5), pp. 685-700. DOI: 10.2495/SDP-V10-N5-685-700

[7] A.D. Basiago, "Economic, social and environmental sustainability in development theory and urban planning practice", The Environmentalist, 1999, vol. 19(1), pp. 145-161. DOI: 10.1023/A:1006697118620

[8] F. Guijarro F., J.A. Poyatos, "Designing a sustainable development goal index through a Goal programming model: The case of EU-28 countries", Sustainability, 2018, vol. 10(9), pp. 31-67. DOI: 10.3390/su10093167

[9] J.A. Sathaye, A. Najam, C. Cocklin, T. Heller, et al., "Sustainable Development and Mitigation", Climate Change 2007: Mitigation. Contribution of Working Group III to the 4th Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007, pp. 691-743.

[10] R. Kapur, "Natural resources and environmental issues", Journal of Ecosystem & Ecography, 2016, vol. 6(2), pp. 1-4. DOI: 10.4172/2157-7625.1000196

[11] M.J. Howes, L. Wortley, R. Potts, A. Dedekorkut-Howes, et al., "Environmental sustainability: A case of policy implementation failure?", Sustainability, 2017, vol. 9(2), p. 165. DOI: 10.3390/su9020165

[12] Y. Dong, M.Z. Hauschild, "Indicators for environmental sustainability", Procedia, 2017, vol. 61(1), pp. 697-702. DOI: 10.1016/j.procir.2016.11.173

[13] S. Sala, B. Ciuffo, P. Nijkamp, "A systemic framework for sustainability assessment", Ecological Economics, 2015, vol. 119, pp. 314-325. DOI: 10.1016/j.ecolecon.2015.09.015

[14] T.M. Parris, R.W. Kates, "Characterizing and measuring sustainable development", Annual Review of Environment and Resources, 2003, vol. 28(1), pp. 559-586. DOI: http://dx.doi.org/10.1146/annurev.energy.28.050302.105551

[15] E. Neumayer, "The human development index and sustainability – a constructive proposal", Ecological Economics, 2012, vol. 39(1), pp. 101-114. DOI: 10.1016/S0921-8009(01)00201-4

[16] D. Lin, L. Hanscom, J. Martindill, M. Borucke, et al., "Working guidebook to the national footprint accounts", Oakland: Global Footprint Network, 2016.

[17] C. Bohringer, P. Jochem, "Measuring the immeasurable – a survey of sustainability indices", SSRN Electronic Journal, 2007, vol. 63(1), pp. 1-8. DOI: 10.1016/j.ecolecon.2007.03.008

[18] R. Lagravinese, "Economic crisis and rising gaps North-South: evidence from the Italian regions", Cambridge Journal of Regions, Economy and Society, 2015, vol. 8(2), pp. 331-342. DOI: 10.1093/cjres/rsv006

[19] E. Giannakis, A. Bruggeman, "Regional disparities in economic resilience in the European Union across the urban – rural divide", Regional Studies, 2020, vol. 54(2), pp. 1200-1213. DOI: 10.1080/00343404.2019.1698720

[20] V. Spaiser, S. Ranganathan, R.B. Swain, D.J.T. Sumpter, "The sustainable development oxymoron: quantifying and modelling the incom-patibility of sustainable development goals", International Journal of Sustainable Development World Ecology, 2016, vol. 24, pp. 457-470. DOI: 10.1080/13504509.2016.1235624

[21] H. Rahma, A. Fauzi, B. Juanda, B. Widjojanto, "Development of a Composite Measure of Regional Sustainable Development in Indonesia", Sustainability, 2019, vol. 11, pp. 58-

61. DOI: 10.3390/su11205861

[22] V.V. Klimanov, S.M. Kazakova, A.A. Mikhailova, "Retrospective analysis of the resilience of Russian regions as socio-economic systems", Voprosy Ekonomiki, 2019, vol. 5, pp. 46-64. (In Russ.). DOI: 10.32609/0042-8736-2019-5-46-64

[23] M.Yu. Malkina, "Assessment of resilient development of the regional economies based on Mahalanobis distances", Terra Economicus, 2020, vol. 18(3), pp. 140-159. (In Russ.). DOI: 10.18522/2073-6606-2020-18-3-140-159

[24] B. Klauer, B. Bartkowski, R. Manstetten, T. Petersen, "Sustainability as a Fair Bequest: An Evaluation Challenge", Ecological Economics, 2017, vol. 141, pp. 136-143. DOI: 10.1016/j.ecolecon.2017.06.001

[25] E.A. Tretyakova, T.V. Miroliubova, Yu.G. Myslyakova, E.A. Shamova, "Methodical approach to the complex assessment of the sustainable region development in the condition of greening the economy", Bulletin of Ural Federal University. Series Economics and Management, 2018, vol. 17(4), pp. 651-669. (In Russ.). DOI: 10.15826/vestnik.2018.17.4.029