

## Article

# Sustainability Assessment of Social and Economic Development of Municipalities in the Voronezh Region

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**Abstract:** In Russia, the issue of improving socio-economic sustainability of municipalities in the region through the assessment of its indicators are particularly relevant. The aim of this work is to assess the sustainability of socio-economic development of municipalities in the Voronezh region. The paper uses a systematic approach for a comprehensive, structured and dynamic study of the state of socio-economic sustainability of municipalities in the region. This approach uses the methods of classification and comparative analysis. The authors propose a methodology for assessing the sustainability of socio-economic development of the region's municipalities. The results of calculating the integral sustainability index indicate the presence of five groups of municipalities, characterized by a particular degree of socio-economic sustainability, ranging from high to crisis. The proposed methodology for assessing the sustainability of socio-economic development of municipalities allows us to highlight the problematic parameters of socio-economic development within the municipalities themselves and to identify the main strategic objectives on the way to a single strategic goal: improving the level and quality of life of the population. Regional policy measures to equalize the level of socio-economic development should be designed, taking into account the identified features of the territorial development of municipal districts.

**Keywords:** municipalities; socio-economic sustainability; integral index; Voronezh region

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## 1. Introduction

The presence of fundamental approaches to the justification of the sustainable development concept at the mega- and macrolevels is currently impacted by the practical absence of systemic theoretical and model representations about the mechanisms of sustainable development management of socio-economic systems at the mesolevel. The conceptual framework of sustainable development management of socio-economic systems of individual regions, although taking into account nationwide approaches to sustainable development management, is nevertheless formed under the influence of the specifics of system organization of the economy of a particular region [1–3]. The global processes of globalization and regionalization, on the one hand, and the processes of market transformation of the economy and modernization of federal relations in Russia, on the other hand, determine their multidirectional and contradictory impact on the sustainability of regional socio-economic systems within a single national market space. In this regard, there is an objective need to develop regional sustainable development management models in order to aggregate these consistently into, first, an emergent inter-regional model and, then, into a national model. The problem of sustainable development at the mega- and macrolevels is mainly considered from the anthropocentric approach,

which focuses on reconciling the goals of socio-economic development with the limited capacity of the ecological system. The reproductive approach to the sustainable development of the region's socio-economic system allows us to present it as a holistic system with multifaceted economic, innovation, social and environmental development features, ensuring the implementation of the systematic principle in the study of sustainable development issues [4,5]. The transition to a new paradigm of sustainable development management of the region's socio-economic system requires: studying the internal mechanism of its sustainable development; determining its driving forces and imperatives; constructing the spatial and temporal models of the comprehensive assessment of sustainable development of the region's socio-economic system; taking into account the susceptibility of the current economic environment to innovation; and balancing development of systemic elements of regional economy and the stability of its indicators dynamics. Under modern conditions, the role of municipalities in terms of the socio-economic development of the country is increasing, as their territories concentrate significant reserves for increasing economic growth, reducing the differentiation of living standards, and forming and implementing effective management actions. Municipalities are the basis of the entire socio-economic system of the region; a fact which highlights the need to improve the effectiveness of municipal governance [6,7].

Addressing emerging governance issues is an urgent challenge for the federal, regional and local administrations, as well as for members of the local community. Each of these have an interest in improving the quality of life of the population and the successful development of businesses and organizations operating in the area. In world practice, management tools at the federal, regional and municipal levels are usually developed using the concept of sustainable development. The special task of developing the directions of sustainable development of municipalities is to: identify measures to strengthen the economic integrity of the region; reduce differentiation in terms of the levels of development of territories; and accelerate inter-municipal integration based on the elimination of administrative and economic regional barriers, improvement of market and transport infrastructure, and creation of unified environmental, economic and social space. The ultimate goal of the sustainable development management of territories is the expanded reproduction of the population under appropriate socio-economic conditions. At the same time, it is important to create conditions for solving problems, such as ensuring full employment and social justice, growth of real wages, rational use of resources, and expansion of social infrastructure. However, theoretical and methodological foundations for assessing the sustainability of the socio-economic development of municipalities in the region (in our case, in the Voronezh region), have not yet been sufficiently developed, although such developments are demanded in practice. Therefore, the high theoretical and practical importance of research into the issues of assessing the sustainability of the socio-economic development of municipalities and the insufficient degree of their development determine the relevance of this study [8–10].

Regional development is shaped by trends in the country's socio-economic development, the availability of human capital, the level and quality of life of the population, and the capacity for rational use and reproduction of natural resources. At the same time, imbalances of development both within individual regions and imbalances in terms of the level of development of different regions can disrupt national security. This is why not only the sustainable development of the country is important, but also the sustainable development of its regions and municipalities. At the same time, the development of national strategies is only an outline of the country's development priorities. The real achievement of these priorities takes place at the local level [11], and is based on the individual potential of each region. It should also be remembered that the policy of aligning regional development, adopted by the EU [12], is ambiguous in countries with different rates of socio-economic development. The systemic management of sustainable development is of great theoretical and practical importance, since the

effective use of the potential of both an individual country and its regions for sustainable development is only possible through conscious, purposeful, and science-based action to transform regional systems. Despite the activity of scientific search in this direction, some aspects of the implementation of measures to ensure the sustainability of the regional economy show new problems in terms of the practical and scientific-methodological content [13]. In addition, recently, managerial state and regional decisions have been made without a clear understanding of the systemic nature of the issue of sustainable development in the individual territory, and, at times, a lack of adequate financial support in the implementation of measures for the management of territorial development. This is why the theoretical and methodological foundations for ensuring the sustainability of regional development, as a condition for strengthening the creation of effective potential of territories with the effective consequence of improving the quality of life of the population and human potential, need to be further fleshed out. Nowadays, human capital provides competitive advantages on the scale of national and regional economies to a much greater extent than material resources [14–16].

A significant number of scientific works, both foreign and Russian, are devoted to the study of human capital essence and the estimation of its value. The studies of human capital have mainly focused on problems manifested at the level of a human capital holder or at the level of a firm that uses it, as well as on the impact of human capital on the development of economic systems. At the same time, the problems of creating conditions for the formation and development of human capital as the basis for sustainable economic growth and increased competitiveness of any Russian region are increasingly becoming the focus of state and regional authorities. For example, it is noted that it is necessary to activate factors, such as competitiveness, as the high quality of human capital, and it is possible that, on the basis of providing the environment, that conditions “favorable for human life and development” can be achieved. Thus, management decisions should be aimed at creating attractive conditions for the formation, development and use of human capital. In this regard, the assessment of the sustainability of socio-economic development of the region’s municipalities is relevant, since the identified problems in their development make it possible to formulate certain directions of regulatory or managerial impact, in one way or another, concerning human capital [14–16].

The Voronezh region (Figure 1) is one of the largest industrial centers in Central Russia.



**Figure 1.** The location of the Voronezh region on the map of Russia.

It is characterized by a diversified structure with an elemental base, represented by machine building and metalworking; chemical, petrochemical, electronic, aircraft, rocket and space industries; building materials industry; and industries oriented towards satisfying the final needs of the population (e.g., food, light industry). The leading

industrial sectors in the Voronezh region are: electricity generation; food production; chemical production; manufacture of rubber and plastic products; transport vehicles and equipment; machinery and equipment; electrical, electronic and optical equipment; metallurgical production and the manufacture of finished metal products; and manufacture of other non-metallic mineral products. The Voronezh region is home to all major manufacturing industries: oil and gas equipment, heavy mechanical presses, mining and processing equipment, machine tools, synthetic rubber, car tires, bridge structures, and sophisticated radio electronic complexes. Voronezh enterprises produce IL-96 airbuses (the only Russian production of wide-body, long-haul passenger planes), rocket and space engines, communications equipment, bridge structures, synthetic rubber, mineral fertilizers, car tires, small electric motors, mining and processing equipment, cement, reinforced concrete products and structures, sugar, vegetable oil, confectionery and pasta products, mayonnaise, alcohol, and more. The Voronezh region accounts for more than 10% of Russia's total synthetic rubber output, 10% of electricity generated by nuclear power plants, and about 4% of mineral fertilizers. An important characteristic of the industrial sector is the presence of large enterprises of federal importance, whose stability of operation is guaranteed by federal target programs or by the system of state defense contracts (enterprises of nuclear energy and the defense industry complex).

Despite the fact that the Voronezh region in the Central Federal District occupies a leading position in many socio-economic indicators, there are significant disparities in the development of municipalities within the region. The result of the growing disparities in socio-economic development of municipalities within one region is disproportionate development of problem municipalities with a constant increase in their level of subsidization. The Voronezh region, like many other constituent entities of the Russian Federation, is characterized by heterogeneous development of municipalities. The asymmetry in the socio-economic development of municipalities leads to problems in the formation of investment, fiscal policy, planning the development of socio-economic sphere of the region, and more. All of this determines the relevance of this issue and the need for a qualitative assessment of the sustainability of socio-economic development of municipalities. Territorial sustainability should ensure the harmonization of economic and social needs of the territory. Accordingly, it is necessary to study a wide range of indicators of both social and economic development in order to assess the balanced development of municipalities.

Improvement in the methodological bases and methods of analysis of condition and sustainability of development of regional systems is a necessary condition for the improvement of quality of management decisions on the basis of more reliable analysis, prognosis and objective substantiation of strategic directions of development of economic complex, social and ecological spheres of territories. Different authors propose different methodological bases and methods for assessing the sustainability of regional socio-economic systems of different levels [17–19].

In the domestic economic literature, there are different approaches to the interpretation of the concept of sustainable development of territories, and, consequently, to the assessment of sustainability of their development. V.E. Rokhchin [20] points out the ambiguity of such interpretations. He distinguishes three established directions of research into the content of this concept: (1) sustainable development is interpreted as economic growth, providing satisfaction of material and spiritual needs of present and future generations, while maintaining the balance of ecosystems; (2) as stable socio-economic development that does not destroy the natural basis, and; (3) as a stable improvement of the quality of life of the population.

In O.S. Pchelintsev's [21] interpretation, sustainable development is an extension of the concept of integrated regional development based on the reproductive approach. Sustainable development implies a transition to the management of the entire set of economic, social and natural processes in the territory, the coordinated solution of the issues of production and settlement location, and the economic system of sustainable development

acts as a “reproductive economy”. A number of other authors also use the reproductive approach in interpreting the concept of sustainable development.

V.A. Kretinin [22] studies economic sustainability of a region, singling out innovation and investment activity, financial sustainability, economic efficiency, environmental sustainability and reproductive comprehensiveness as its main components. He considers reproductive comprehensiveness, not only as a component of economic sustainability of the regional economic system, but also as a factor influencing its other components—environmental sustainability, investment activity and economic efficiency.

When considering the content of the concept of sustainability of socio-economic development of the country’s territory and its regions, A.S. Martynov, V.V. Artyukhov and V.G. Vinogradov [23] proceed from the fact that sustainable development is a fundamental property of systems, which distinguishes them from a random set of elements. Considering Russia as a system, they distinguish three subsystems in its structure—natural resources, material and technical complexes, and society, noting that the sustainability of development as a property of systems applies to each of these subsystems. Thus stability of material systems depends on three characteristics—extensive (material-energetic potential), intensive (processes of reproduction and exchange), and information (structure and composition). The set of indicators they propose, reflecting these characteristics, allows for evaluating the sustainability of development of material and technical complexes as a system, and choosing the optimal material and technical development investment strategy for each region. The authors consider sustainability of the society as the ability of the region’s population to maintain their living wellbeing and social stability, on the one hand, and as an important factor in the development of productive forces, on the other hand.

V.N. Lazhentsev [24] considers sustainability and self-development to be among the main properties of regional economic systems. These properties together characterize the ability of regional economic systems to create and comprehensively use infrastructural, labor and natural resource potential.

G.V. Gutman, A.A. Miroedov, S.V. Fedin [25] point out the region’s ability to function as a self-developing system as its most important functional characteristic, and consider the sustainability of socio-economic development of the region as the antipode of its crisis state. B. Vasilenko [26] uses close interpretation, considering sustainability as a crisis-free (or safe) development of the territory, and, as a basis for the strategic analysis of sustainability of development of territories, he proposes to use a set of indicators of risk-free standards of sustainable development, taking into account the main forms of risk-free territories—economic, social, environmental. I.A. Korneev, P.I. Munin, Y.L. Yegorov, A.A. Nikiforova [27] point to the need to develop an integral indicator of sustainability of development of a territorial unit and an algorithm for its calculation. In their opinion, the use of such an indicator will make it possible to identify the most significant characteristics of the territory, to determine the dynamics of sustainable development of the territory, and to compare different territories with each other in terms of sustainability of their development.

Zhuravlev D. ([28] proposes the use of economic and mathematical modelling of the processes of socio-economic stabilization and the sustainable development of regions, as well as multi-purpose forecasting and multi-purpose optimization of guaranteed solutions of priority problems as a tool for research of trends and development of multi-purpose programs of sustainable development of regions, proposing the minimization of financial resources and increasing the reliability and accuracy of such solutions as the main objective of such optimization.

Thus, despite the different interpretations of the concept of “socio-economic sustainability of the territory”, the basis of this concept is the understanding of crisis-free or safe development of the area, due to the influence of many factors of the external environment and the presence of certain internal territorial conditions of development of the area.

When considering the concept of a “municipal entity”, most researchers rely on the norms of Federal Law No. 131 of 06.10.2003, “On General Principles of Organization of Local Self-Government in the Russian Federation” [29], and interpret it either as a territorial entity in which citizens, through a set of organizational forms, exercise local self-government, or substitute it with the systematization of types of municipalities—urban (rural) settlement, municipal district, urban district, or inner city territory of a city of federal significance.

Without rejecting these approaches as a whole, it should be noted that they are limited in their emphasis on the legal aspects of the territorial organization of the country, while the socio-economic essence of the municipality remains unexplored. To fill this gap, in our view, it is possible to use a systematic approach, in which the disclosure of the essence of a municipality is possible through its structuring and the selection of subsystems and elements, the functioning of which determines the specifics of a particular territory (Table 1).

**Table 1.** Structuring a municipal system.

No	Subsystems of the Municipality	Elements of a Municipality	Entities of a Municipality	Objects of a Municipality
1	Territorial	Area	–	Area
2	Economic	Municipal economy	Business	–
3	Social	Society	Population (society)	–
4	Institutional (managerial)	Authorities	Authorities	–

As can be seen from Table 1, the traditional view of a municipality as a territory with a certain natural resource potential, which is the basis for the life of people and distribution of productive forces, reflects only the objective component of its essence.

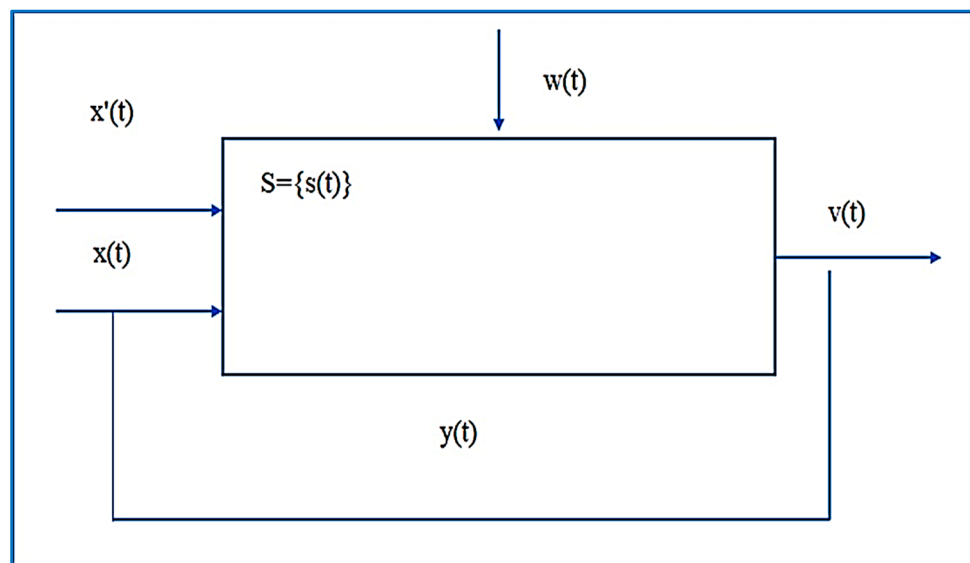
However, the territorial component alone is not enough to call a territory a municipality. Its formation is the result of interactions between the territorial subsystem and purposeful activity of the population as an aggregate of individuals living on a certain territory and consisting of socio-economic relations which concern the disposal of resources in the sphere of production, distribution, exchange and consumption.

Accordingly, a necessary prerequisite for the formation of a municipality is the presence of its actors, primarily the population, and society, as well as its forms of organization—municipal economy (represented by municipal enterprises, institutions, organizations of other forms of ownership, and their associations) and government (represented by local government, territorial representations of federal and regional public authorities).

The functioning of socio-economic systems, which include municipalities, can be represented as a dynamic system with input, output, process and feedback (Figure 2). In the figure,  $x(t)$  and  $x'(t)$  are the influences of the external environment (uncontrolled and controlled, respectively) or the so-called input influences—they include changes in the external environment, resources, laws of society;  $S = \{s(t)\}$ —set of internal states;  $v(t)$ —system response;  $w(t)$ —random or unobserved disturbances; and  $y(t)$ —feedback (can be positive and negative) [9]. The inputs are interpreted as independent, while the set of states and the system response are interpreted as dependent variables.

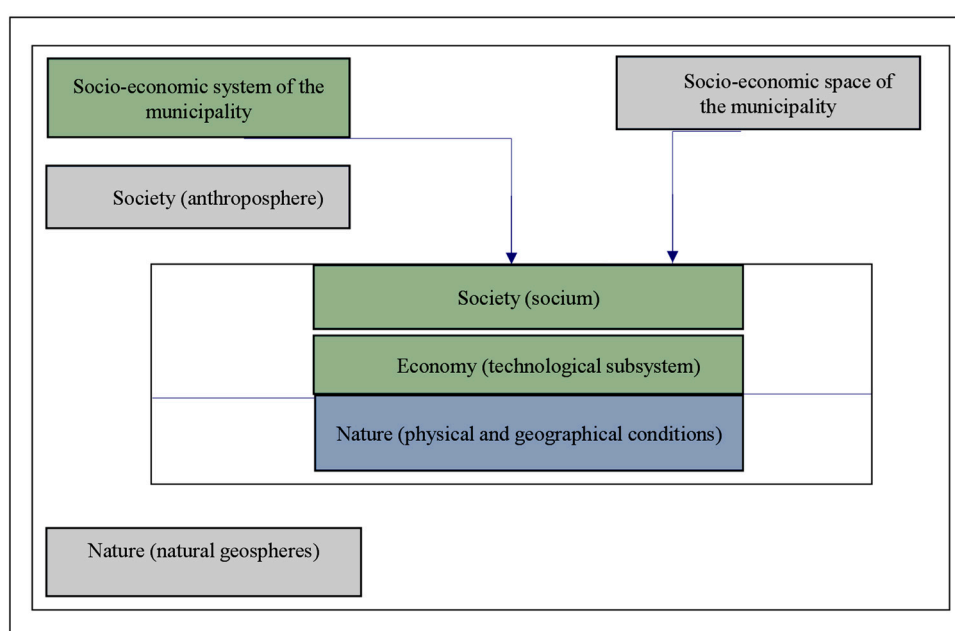
Based on certain studies in the definition of the concept of “system”, we assume that a system is “a set of elements organized in such a way that the change, exclusion or introduction of a new element naturally affects the other elements” [28]. The analysis of existing approaches to defining the concept of “system” allows us to conclude that the differences in them are based on the differences in the authors’ subjective understanding of the system properties. In addition, the system should meet two requirements: (1) the behavior of each element of the system affects the behavior of the system as a whole, and its attributes are lost when the system is decomposed; and (2) the behavior of system elements and

their interaction, on the whole, are interdependent—the essential properties of system elements are also lost when they are separated from the system [10].



**Figure 2.** Dynamic system model.

Schematically, the model of the socio-economic system of a municipality can be represented as follows (Figure 3).



**Figure 3.** Model of the socio-economic system of a municipality.

The purpose of the study is to assess the socio-economic sustainability of municipalities in Voronezh region.

## 2. Materials and Methods

The authors use a systemic approach for a comprehensive, structured and dynamic study of the state of the level of socio-economic sustainability of municipalities in the region. This approach uses the method of classification, which identifies and limits the existing conceptual approaches to the interpretation of conflict as an economic category, and

the method of comparative analysis, which compares the identified approaches with each other. The information and analytical basis of the study consists of the works of foreign and Russian authors on the stated research topic. The formation of the database was carried out, in retrospect, for the period of 2014–2018.

The interdisciplinary, multidimensional and multi-level nature of the problem of sustainable development of regional socio-economic systems has necessitated the use of the following set of theoretical and methodological approaches in the process of its study:

- anthropocentric approach, according to which sustainable development implies a balanced solution of socio-economic development tasks for the future and preservation of the favorable state of the environment and natural resource potential in order to meet the vital needs of the territory's population;
- evolutionary-cyclical theory and dynamic disequilibrium theory, which have high resolution capabilities to study the transformation, dynamics, integration and differentiation of regional systems in the system of developing social relations;
- general systems theory, which studies the socio-economic system as a complex multi-layered, multi-structured, hierarchical system consisting of many different-quality components (subsystems, structures, elements) linked by various types of relations and connections, as well as synergy effects;
- neoclassical and institutional theories which place different emphases on the choice of drivers of regional development, analyzing the manifold aspects of causality in the spatial economy;
- theories and concepts of regional development—theories of production location, the concept of “growth poles”, the theory of comparative advantage—which substantiate the specifics of the development of territorial socio-economic systems.

In developing the problem, we used a wide range of epistemological tools, including methods of systemic, structural-functional and comparative analysis; economic-mathematical (vector algebra methods) and information modeling; phenomenological analysis; statistical methods (partial ranking, correlation analysis, index methods); and programming tools. The combination and targeted and selective use of the analytical-heuristic potential of each of these particular techniques for addressing the stage tasks of this study, ordered by a single algorithm to achieve the goal, ensured the validity of estimates and the reliability of the obtained conclusions.

The information base of the study was based on official data of the Ministry of Regional Development, Ministry of Economic Development, Department of Economy of Voronezh region, Federal State Statistics Service and its territorial body, publications in scientific publications, current information on the activities of the Russian Federation Government and the Voronezh region, Internet materials, as well as estimated data obtained as a result of the study.

In the Russian Federation, the need to organize, collect and provide local government bodies with data on the socio-economic development of municipalities has been legally established. In accordance with Federal Law No. 131, “On General Principles of Organization of Local Self-Government in the Russian Federation”, the powers in this area include the “organization of the collection of statistical indicators that characterize the state of the economy and social sphere; provision of the above data to public authorities, communication of official information on the socio-economic and cultural development of the municipal entity to the residents” [29].

The basis of the normative legal support for evaluating the performance of a local government is Article 18.1 of Federal Law No.131. Evaluation of the effectiveness of a local government is aimed at identifying areas of priority attention and at developing a set of measures to improve the performance of local governments. At the federal level, Decree No.607 of the President of the Russian Federation “On the evaluation of the effectiveness of the activities of the local governments of urban districts and municipal areas” [30] and



Government Decree No.1317, dated 17 December 2012, have defined indicators, monitoring methodology, forms of reports of heads of local governments, methodological recommendations on allocation of grants to municipalities and also rules of performance evaluation of local governments by population [31].

The level of sustainability of the socio-economic development of municipalities is practically impossible to be expressed in a single indicator, which necessitates a comprehensive (generalized) assessment. To date, the assessment of socio-economic development has been carried out using different approaches: by means of individual indicators, integral methods, and SWOT-analysis, etc. The main way to solve the problem of assessing the territory is the calculation of integral indicators. The Russian Federation uses integral assessment techniques, which differ in their composition, i.e., the total number of indicators of development aspects. Such methods include: the method of assessing the effectiveness of the strategy of socio-economic development of regions and the method of assessing the level of socio-economic development of regions. The large number of indicators in the method for assessing the sustainability of the socio-economic development of a territory makes it possible to comprehensively evaluate various aspects of development at the appropriate level [32,33].

This method is key, although it does not cover all possible indicators that need to be assessed. Despite many methodological developments in the subject area under consideration, their application does not always allow for an adequate reflection of the level and trends of socio-economic development. The existing methodologies do not contain sufficient data, which would enable the full interpretation of the results of the assessment. In this case, a significant amount of information is lost due to the narrowness of the applied methods, which evaluate either the dynamics of the socio-economic situation or generalized statistics. In addition, a number of methodologies use a strictly established estimation system, which is not adaptive, making it difficult to apply in other contexts. As a result, factors affecting the economy and social sphere are perceived incorrectly. Most methods do not practically take into account the subjective component. As a consequence, public opinion is not taken into account by the authorities, which can be quite divergent from their understanding of the area's development.

Each region uses different assessment methodologies, and hence it is not possible to compare territories at the municipal level. One of the basic principles of assessing the level of sustainability of socio-economic development is the objectivity of indicators. However, some methodologies use subjective data obtained from sociological observations, which reduces the degree of objectivity in the final integral assessment. A particular contribution to the integral assessment is made by indicators describing the dynamics of development. Such indicators are able to assess the extent to which the municipality has changed its position over the past period.

The following software packages were used for the solution of the tasks. Microsoft EXCEL and STATISTICA 6.0 application software packages were used in solving the tasks. The information-empirical base of the study was formed on the basis of official data of the Federal State Statistics Service, departmental reports and accounts, as well as materials of monographic studies by domestic and foreign scientists. The representative totality of used statistical data, respectively processed, analyzed, summarized, economically interpreted and commented, ensured the reliability of the study results and the reasoned validity of practical recommendations.

### 3. Results

Socio-economic development of a territory, which combines two equivalent components, namely economic and social categories, represents qualitative changes in the socio-economic environment, corresponding to the goals of improving the welfare and quality of life of the population in a particular territory, both in terms of the country as a whole and a particular region or municipality.

Significant contributions to the development of a framework of indicators and tools for assessing the sustainability of territories have been made by international and regional organizations: The Driving Force-State-Response (DSR) model developed by the United Nations Commission on Sustainable Development (UNCSD) (Commission on Sustainable Development, 2001); The Pressure-State-Response (PSR) model of the Organization for Economic Cooperation and Development<sup>1</sup> (OCED) (Organization for Economic Cooperation and Development, 2001); the Society—Economy—Environmental Model proposed by the United Nations Environment Program (UNEP) (Global Reporting Initiative, 2002); and the Extending the Wealth Measure: Indicators of the World Bank's Sustainable Development Model [8–12]

In order to identify a particular group of statistical indicators, it is necessary to identify those phenomena and processes in the economy that are to be studied and to find out their essence. The main step in calculating the indicators is the process of developing a methodology for defining their composition, i.e., the elements to be covered by a particular system of indicators.

Statistical indicators are used in two forms: statistical indicators act as indicators; indicators from statistical indicators, which serve to determine the presence or measurement of an investigated subject. A system of statistical indicators is used to characterize certain categories. The main category for the evaluation and selection of an indicator is the degree of its informativeness, which is manifested in the possibility of a model for the calculation of this indicator.

The calculation model captures the essence of the estimation and justification of the conclusions. A defined system of statistical indicators describing a socio-economic subject is a kind of operational model, capturing its state and development trend. It is built on the basis of a conceptual substantive model of the object, and on the research principles adopted in a particular science. The list of indicators that characterize the object of study includes those indicators that are more sensitive and have a greater calculability.

The system of indicators of socio-economic development of the region is a complex hierarchical structure with many private indicators, which, depending on the management task, can include criteria reflecting the social, economic and other effects of the regional system development. The system of indicators of regional development is a comprehensive model that characterizes the state of the region and makes it possible to judge the relative level of its development. In addition, the system of indicators is a tool for linking strategic and operational management on the basis of key performance indicators and the cause-effect relationships between them.

The system of indicators forms an integrated criterion reflecting the standard of living of the population in the region; provides a summary assessment of the social parameters of the region (including population, education, health, culture, standard of living); and characterizes, in general, the objective economic (finance, investment, manufacturing, enterprises and organizations) conditions of the region.

These groups form the most adequate system of indicators that determine both the level of socio-economic development of the region and the socio-economic efficiency of the region. It should be noted that these indicators are interrelated. The chain of interaction is based on the cause-effect relationship. The system of indicators of socio-economic development describes various aspects and conditions that are important for the region. The proposed set of indicators is approximate and can be supplemented or changed for a more objective and complete assessment of socio-economic development of the region, as well as for the elaboration of a list of measures to achieve strategic aims.

The following are the individual statistical indicators that characterize the manifestations of the study—the indicator concepts. The indicator concepts are a socio-economic category that indicates the qualitative level of development. The system of indicators is considered in terms of four socio-economic aspects: economic, environmental, international and informational.

The following requirements should be taken into account when constructing a sustainability assessment framework:

- preference should be given to indicators that are dynamic in nature rather than those that are stable or change slowly over time;
- 9–10 criteria are sufficient to describe a system of any complexity;
- the indicators should create the preconditions for a rapid and comprehensive assessment;
- the indicators should describe the effect of the most important factors;
- the formation of the system of indicators should be based on a combination of two principles—completeness of the coverage of impact factors and the minimum number of indicators.

The formalization of the vast majority of socio-economic research tasks predetermines the possibility of the wide use of modern economic and mathematical methods and models for their solution. This is facilitated by the mass, typical and repetitive nature of a significant number of such tasks and data processing procedures. However, the need to take into account a large number of diverse indicators in order to describe the processes and phenomena under study as fully as possible, the presence of attributes that only indirectly reflect the most significant, but not amenable to direct observation and measurement, internal, hidden properties of phenomena, complicate the data processing procedures.

One of the most important tasks arising in the processing of multivariate statistical data is aggregation, which aims at compressing the feature space without significant loss of information content. A widespread approach to the aggregation of empirical data is to move from initial indicators, whose values are measured on objects, to a small number of some generalized indicators that are functionally related to the initial indicators and have some criterion-optimal properties. In practice, the aggregation of initial indicators is often considered in the context of a complete scalar reduction, which results in the construction of a single, so-called generalized or integral indicator.

The integral indicator will be understood as a conditional numerical measure of the latent quality of the phenomenon under study. The construction of a generalized indicator is based on the definition of its concept. At the theoretical level, conceptualization reflects the definition of goals, objectives, methodological principles and approaches to its construction, requirements for its quality and directions for the interpretation of the results obtained. The main purpose of constructing an integral performance indicator is to try to make the assessment simpler and more easily understood, which will simplify the analysis of the final result, and make the procedure of drawing conclusions simpler and more obvious. Based on the factors that have the greatest impact on the sustainability of municipal socio-economic development, a group of economic and social indicators is proposed.

The grouping of partial indicators into components and constituents is done using the simple arithmetic mean formula. The integral indicator of the sustainability of municipalities is calculated as the sum of the ranks of its components. According to the logic of construction of the components, the components of the integral sustainability index cannot exceed 100%, which simplifies the analysis and the identification of problems.

At the first stage, the statistical indicators presented in Table 2 are taken as the initial indicators of social and economic development of the territory. After determining the estimated indicators, it is necessary to calculate the average coefficient of sustainability ( $Y_{average}$ ), the average coefficient of development dynamics ( $D_{average}$ ) and the final integral coefficient of socio-economic development ( $I$ ):

$$I = \frac{Y_{average} + D_{average}}{2} \quad (1)$$

**Table 2.** Economic and social indicators for assessing the socio-economic sustainability of a region.

	Name of Indicator	Method of Calculation
Economic	Volume of paid services	Paid services per capita
	Commissioning of residential buildings	Number of dwellings in square meters per 1000 inhabitants
	Total retail and catering turnover	Ratio of the sum of retail trade and catering per capita
	Volume of investment in fixed assets	Fixed capital investment per capita
	Average wages for employees of organizations	The average wage of employees in organizations
Social	Fertility rate	Average number of births during the year per 1000 population at mid-year
	Mortality rate	Number of deaths during the year per 1000 population at mid-year
	Crime rate	Ratio of reported crimes per 100,000 population
	Road density	Length of paved roads per 10,000 km square area
	Hospital bed capacity	Number of hospital beds per 1000 inhabitants

When determining  $Y_{av}$ , it is necessary to give each initial social and economic indicator a weight based on the benchmark value. If the indicator stimulates development, i.e., its growth reflects positively on the region:

$$K_i = \frac{x_i}{\max_i} \quad (2)$$

If the indicator is negatively affected:

$$K_i = \frac{\min_x}{x_i} \quad (3)$$

where:

$K_i$ —the level of development of the region for the  $i$ -th indicator;

$x_i$ —value of the indicator;

$\max x_i, \min x_i$ —the reference value, which can be a threshold value for the indicators.

Next, we calculate the integral indicators of economic and social sustainability (4). In order to get rid of negative values, it is necessary to square the indicators, find their arithmetic mean and extract the square root:

$$Y_j = \sqrt{\frac{\sum_{i=1}^n k_i^2}{n}} \quad (4)$$

where:

$Y_j$ —an indicator of the sustainability of each component;

$n$ —the number of indicators.

We then determine the sustainability ratio (geometric mean).

The sustainability coefficient for ( $i$ ) year is calculated using the formula:

$$Y_i = \sqrt[2]{Y_{econ.} \times Y_{soc.}} \quad (5)$$

where:

$Y_{econ.}$ —economic sustainability,

$Y_{soc.}$ —social sustainability.

Finally,  $Y_{average}$  is found using the following formula:

$$Y_{average} = \frac{Y_{i1} + Y_{i2} \dots + Y_{in}}{n} \quad (6)$$

where:

$n$ —the number of indicators.

In finding the average development coefficient  $D_{average}$ ,  $x_i$  in Formulas (2) and (3) is found as follows:

$$x_t = \frac{x_n}{x_{n-1}} \times 100, (\%) \quad (7)$$

where:

$x_t$ —indicator of the relative development compared to the previous year in (%):

$$x_i = \frac{x_{t1} + x_{t2} \dots + x_{tn}}{n} \quad (8)$$

where:

$n$ —is the number of indicators.

We then repeat the calculation using Formulas (2)–(6) and find  $D_{av}$ .

By using Formula (1), we then find the final integral coefficient of socio-economic development.

The next step is to determine the number of clusters and the threshold values (group interval) of the integral indicator of sustainable development of the region. In our case, we propose to distinguish five clusters of the level of development of municipalities: highly sustainable, above average-oblast, average-oblast, below average-oblast and depressed municipalities. It is important to understand that, when determining the interval of the group, the value of the sign of many socio-economic phenomena, and as a consequence, the final integral indicator, vary unevenly and on a significant scale. As such, in this paper we will use unequal interval, progressively increasing in arithmetic progression:

$$h_{i+1} = h_i + a \quad (9)$$

where:

$h_i$  is the interval value of the first group (depressed municipalities);

$a$  is a fixed number (constant), positive when the intervals are progressively increasing and negative when the intervals are progressively decreasing.

A constant is an indicator that will be positive for gradually increasing intervals and negative for gradually decreasing intervals.

In this case, estimating the variation range of the final integral indicator, we assign the values  $h_i = 0.010$ , and  $a = 0.005$  respectively.

It should be noted that this methodology is quite workable and allows us to

- to measure the actual value of economic and social sustainability of municipalities;
- to carry out a comparative assessment of the sustainability of different territories;
- to identify the factors negatively affecting the sustainability of subsystems and the region as a whole;
- to assess more reasonably the prospects of socio-economic development of municipalities in the region;
- to determine the efficiency of the use of territorial resources;
- to identify the areas of socio-economic activity most appropriate for the development of the region
- objectively assess the effectiveness of regional government bodies and local authorities.

The calculation of summary indicators assumes that all baseline data are interchangeable and that a decrease in the value of one of the standardized indicators is fully compensated in the integral assessment by a positive change in the other standardized value of the baseline indicator.

The first area of integral indicator values characterizes the sustainable socio-economic development of the region. In this area, the factors contributing to a decline in sustainable development and the economy approaching a state of crisis may appear.

The second area of integral indicator values reflects negative trends in the socio-economic processes taking place in the region and warns of a breakdown in sustainable development and a threat to economic security.

The third area of integral indicator values, below the normative and threshold values, represents a crisis zone, in which the equilibrium and sustainable socio-economic development of the region is disturbed and processes leading to a complete collapse are initiated.

The quintessence of all of the scientific research that we have carried out is the derivation of the final integral indicator of sustainable socio-economic development of municipalities in the Voronezh region and the consideration of its territorial aspect.

We propose to distinguish five clusters according to the level of socio-economic sustainability of municipalities: high level of socio-economic sustainability, above average level of socio-economic sustainability, medium level of socio-economic sustainability, low level of socio-economic sustainability, and crisis level of socio-economic sustainability.

It is necessary to combine the indicators into one total, according to the above methodology, so that they can be compared and economic sustainability can be calculated. The level of sustainability of the economic component of the Voronezh region municipalities, is presented in Table 3.

Based on the data obtained, it can be said that, consistently from 2014 to 2018, the Voronezh urban district and the Novovoronezh urban district were among the leaders in terms of economic development, ranking second and third, respectively. The Ramonsky district remains the leader. Apparently, the economic development indicator of these municipalities is two, three, and, in some cases, four times higher than that of the rest of the region's districts.

Next, let us also assess the social component. By combining these indicators into one overall indicator, let us consider the level of the social component of the integral indicator of sustainability (Table 3).

**Table 3.** Index of the level of economic sustainability of municipalities of the Voronezh Region, 2014–2018.

	2014	2015	2016	2017	2018
Voronezh City	0.542	0.587	0.593	0.597	0.585
Novovoronezh City	0.690	0.658	0.667	0.674	0.664
Borisoglebsky	0.316	0.332	0.340	0.353	0.358
Anninsky	0.221	0.232	0.239	0.248	0.245
Bobrovsky	0.255	0.247	0.247	0.287	0.291
Bogucharsky	0.216	0.227	0.240	0.271	0.249
Buturlinovsky	0.245	0.242	0.242	0.252	0.255
Verkhnemamonsky	0.211	0.222	0.226	0.226	0.238
Verkhnehavsky	0.293	0.285	0.286	0.287	0.282
Vorobyovsky	0.204	0.211	0.212	0.207	0.223
Gribanovsky	0.240	0.231	0.236	0.230	0.231
Kalacheevsky	0.266	0.296	0.303	0.310	0.330
Kamensky	0.229	0.254	0.231	0.331	0.231
Kantemirovsky	0.272	0.322	0.252	0.473	0.253
Kashirsky	0.268	0.265	0.270	0.262	0.264
Liskinsky	0.357	0.378	0.388	0.407	0.408
Nizhnedevitsky	0.249	0.272	0.269	0.264	0.265
Novousmanskoy	0.520	0.410	0.406	0.405	0.384

Novokhoporsky	0.227	0.226	0.230	0.231	0.232
Olkhovatsky	0.224	0.233	0.234	0.246	0.241
Ostrogzhsky	0.266	0.271	0.270	0.266	0.268
Pavlovsky	0.251	0.251	0.257	0.257	0.261
Paninsky	0.210	0.210	0.215	0.221	0.227
Petropavlovsky	0.211	0.222	0.211	0.212	0.219
Povorinsky	0.237	0.235	0.227	0.231	0.246
Podgorensky	0.227	0.237	0.238	0.240	0.240
Ramonsky	0.813	0.752	0.749	0.842	0.772
Repyovsky	0.215	0.227	0.219	0.215	0.235
Rossoshansky	0.299	0.313	0.314	0.301	0.301
Semiluksky	0.275	0.279	0.275	0.292	0.289
Talovsky	0.207	0.222	0.228	0.263	0.228
Ternovsky	0.203	0.205	0.207	0.215	0.222
Khokholsky	0.282	0.265	0.258	0.257	0.259
Ertilsky	0.200	0.202	0.203	0.201	0.207

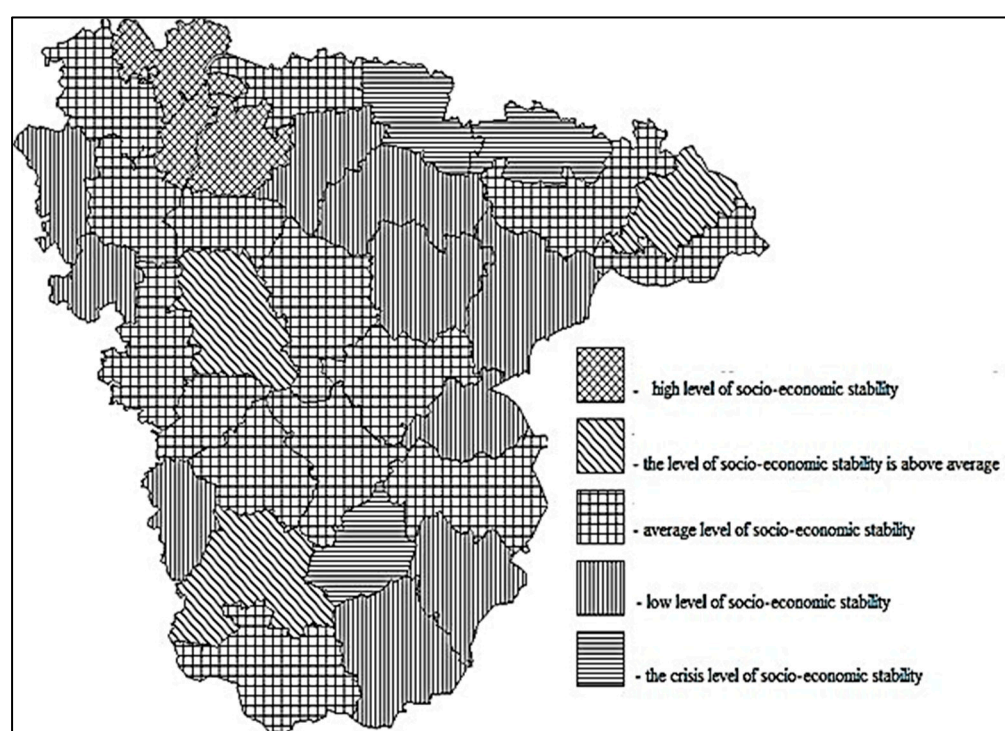
Based on Table 4, we can see that the leaders in social development are also two urban districts, Voronezh and Novovoronezh. At the same time, the gap with other municipalities of the region in social development is significant, but it is not as critical as in the economic indicator, and, on average, is 1.5 times.

By determining the level of sustainability according to social and economic parameters, an integral index of overall socio-economic development sustainability can be calculated (Figures 4 and 5).

**Table 4.** Index of the level of social sustainability of the Voronezh region municipalities for 2014–2018.

	2014	2015	2016	2017	2018
Voronezh City	0.841	0.865	0.880	0.887	0.866
Novovoronezh City	0.801	0.849	0.777	0.804	0.788
Borisoglebsky	0.652	0.629	0.641	0.636	0.627
Anninsky	0.600	0.577	0.584	0.547	0.576
Bobrovsky	0.611	0.553	0.577	0.565	0.582
Bogucharsky	0.632	0.595	0.622	0.640	0.621
Buturlinovsky	0.621	0.595	0.625	0.594	0.577
Verkhnemamonsky	0.561	0.517	0.515	0.537	0.552
Verkhnehavsky	0.578	0.524	0.519	0.528	0.521
Vorobyovsky	0.595	0.564	0.583	0.625	0.596
Gribanovsky	0.627	0.557	0.575	0.594	0.641
Kalacheevsky	0.582	0.567	0.602	0.580	0.569
Kamensky	0.656	0.580	0.638	0.634	0.597
Kantemirovsky	0.617	0.595	0.579	0.592	0.561
Kashirsky	0.547	0.503	0.527	0.520	0.480
Liskinsky	0.663	0.623	0.653	0.659	0.624
Nizhnedevitsky	0.499	0.459	0.495	0.519	0.486
Novousmanskoy	0.653	0.606	0.635	0.642	0.664
Novokhoporsky	0.614	0.558	0.598	0.593	0.571
Olkhovatsky	0.616	0.566	0.597	0.628	0.590
Ostrogzhsky	0.622	0.616	0.602	0.601	0.599
Pavlovsky	0.654	0.575	0.582	0.593	0.602

Paninsky	0.644	0.572	0.553	0.558	0.532
Petropavlovsky	0.642	0.598	0.606	0.623	0.610
Povorinsky	0.732	0.690	0.684	0.639	0.661
Podgorensky	0.631	0.581	0.551	0.532	0.538
Ramonsky	0.534	0.527	0.557	0.564	0.579
Repyovsky	0.614	0.558	0.649	0.617	0.581
Rossoshansky	0.721	0.665	0.688	0.683	0.669
Semiluksky	0.605	0.588	0.589	0.575	0.585
Talovsky	0.593	0.556	0.581	0.578	0.589
Ternovsky	0.595	0.536	0.558	0.570	0.536
Khokholsky	0.567	0.492	0.548	0.539	0.547
Ertilsky	0.586	0.526	0.533	0.552	0.556

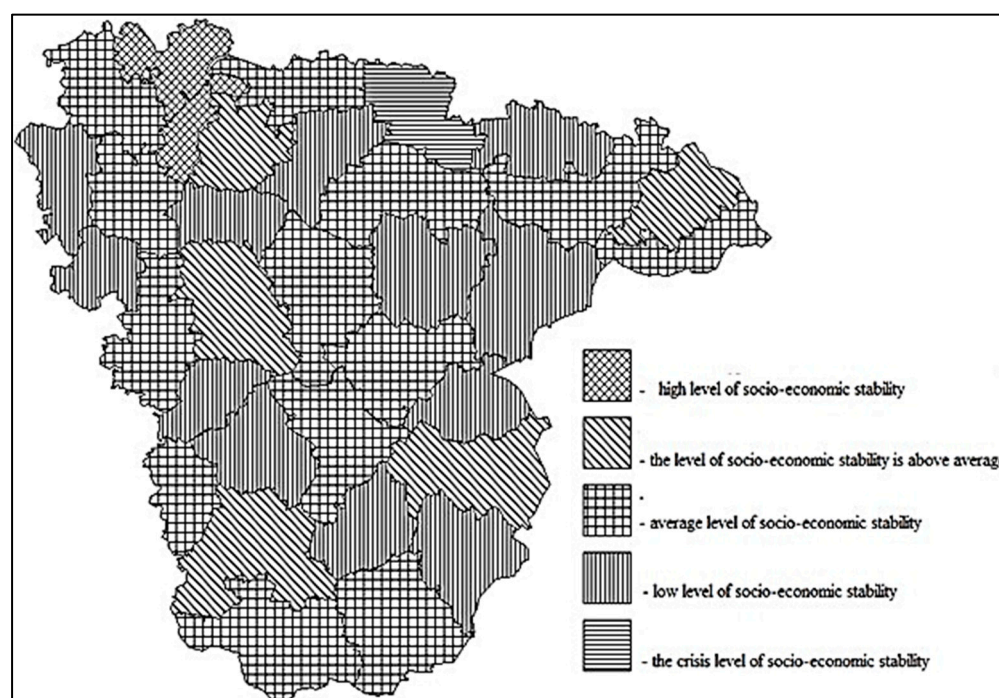


**Figure 4.** The index of socio-economic sustainability of municipalities of the Voronezh region (2014).

The analysis of the calculations shows that, from 2014 to 2016 inclusive, there is a positive trend of alignment of socio-economic development of municipalities. This is expressed, first of all, in the increase in the number of municipalities in the “basic cluster” of medium development, from 14 to 19, due to the reduction in the number of areas with the level of development below average (from 10 to 6) and crisis areas (from 3 to 1).

Thus, in 2016 more than 50% (19 out of 34) of the Voronezh region municipalities had an average level of socio-economic sustainability. However, in the period of 2017–2018 the gap between social and economic parameters increased, and the number of municipal districts with a low level of socio-economic sustainability increased to 12. This indicates an increase in intra-municipal differentiation over the period under consideration and the lack of effective intra-regional policy aimed at reducing the existing socio-economic asymmetry within the subject of the Russian Federation.





**Figure 5.** The index of socio-economic sustainability of municipalities of the Voronezh region (2018).

Based on the analysis of the level of socio-economic sustainability, the following conclusions can be made:

Economic sustainability indicators of the Voronezh and Novovoronezh urban districts are three to four times higher than those of other municipalities in the region. The only district that can compete with the urban districts in the index of economic sustainability is the Ramonsky municipal district.

The gap in the index of social sustainability is not particularly significant, but is still significant between municipalities. In this case, the leaders in terms of indicators of this index are Voronezh and Novovoronezh.

Based on the calculated final integral index of socio-economic sustainability of the municipalities of the Voronezh region we can distinguish five groups:

- high level of socio-economic sustainability (Novovoronezh city, Voronezh city, Ramonsky municipal district);
- above-average level of socio-economic sustainability (Novousmansky, Liskinsky, Borisoglebsky, Rossoshansky, Kalacheevsky municipal districts);
- medium level of socio-economic sustainability (Semiluksky, Bobrovsky, Povorinsky, Ostrogozhsky, Pavlovsky, Bogucharsky, Gribovsky, Buturlinovskiy, Verkhnekhavsky, Olkhovatsky, Kantemirovsky, Khokholsky, Anninsky municipal districts);
- low level of social and economic sustainability (Kamensky, Repyevsky, Talovsky, Petropavlovsky, Vorobyevsky, Novokhopersky, Verkhnemamonsky, Nizhnedevitsky, Podgorensky, Kashirsky, Paninsky, Ternovsky municipal districts);
- crisis level of socio-economic sustainability (Ertilsky municipal district).

#### 4. Discussion

It should be noted that there are significant differences between domestic and foreign systems for assessing socio-economic development. In contrast to Russian methodologies, foreign integral assessments do not include formulations related to the concept of “sustainability of socio-economic development of municipalities”. Foreign methodologies more often use a system of indicators for assessment, while the use of integral assessment is rarely used, sometimes appearing in particular in cases of measuring the social sphere

(e.g., quality of life). The existing foreign methodologies of integral assessments are developed mainly by international organizations and are focused on comparisons between countries, while in Russia there are methodologies related to specific territories (municipalities, regions, federal districts, and the state as a whole).

This can be explained by the fact that foreign methodological problems of sustainable development assessments are similar for both countries and regions. At the same time, the key feature of foreign assessment methodologies is the wide spread of qualitative (expert) assessments whose methodologies are most often not disclosed, which makes it difficult to find their formulations and parameters. The abundance of foreign research centers ensures that there are assessment methodologies designed for each sphere of social and economic development. For example, education is measured by the UNESCO system of indicators, and health by the World Health Organization's "health strategy for all".

Unfortunately, full or even partial use of foreign indicators and expert assessments in the Russian Federation is not possible due to a shortage of independent and authoritative research centers. However, foreign experience in the development of assessment systems is still of interest for studying approaches to the formation of methodologies. The problem in assessing the sustainability of socio-economic development of the Russian Federation municipalities is the lack of a unified system that includes a comprehensive analysis of all aspects of a particular indicator. There is a need for a common methodology, which would cover and take into account all features of the territory, its positive and negative performance indicators, subjective and objective assessments, and an accessible system of interpreting the monitoring results, which was done in this research. Such a methodology could contain a sufficient number of indicators and indicators for a comprehensive assessment, expressed in the form of relative values.

Thus, the proposed methodology, has individual features in limiting the number of basic indicators that relate to the most important areas of the socio-economic system of the region. It, along with existing approaches, makes it possible to determine the level of sustainable socio-economic development of territories, which contributes to obtaining more objective results. This methodology can be used in the development of a regional strategy for socio-economic development.

The socio-economic systems of the region's municipalities are unstable and conflict-prone for certain reasons. First, these systems are complex and have many levels. They include many economic actors, each pursuing their own interests.

The social nature of economic actors leads to their limited rationality, which makes it difficult to predict and manage their behavior. Secondly, as they develop according to the market model, modern economic systems aim at intensive growth and are subject to constant change.

These changes are often in the interests of some economic actors and contrary to the interests of others. Third, socio-economic systems are imperfect, despite numerous attempts to optimize them. Ideal models (including the market economy model) of the development of these systems are very difficult to implement in practice. This process is made more difficult by the differentiation of socio-economic systems and the difficulty of adapting the models to the current level of development of the country as a whole.

The assessment of the sustainability of socio-economic development of municipalities in the Voronezh region has allowed us to identify problem areas and determine the reserves that can improve the sustainability of municipal development and identify areas for the development of human capital.

In order to equalize the level of socio-economic development of the municipalities, a number of strategic tasks need to be solved:

- (1) Stimulation of economic growth points (agglomerations, cities, in particular small towns).
- (2) Strengthening of opportunities for the development of territories in need of state support (macro- and micro-level).

- (3) Counteracting crises in problematic territories (sparsely populated rural areas, border areas, etc.).
- (4) Development of infrastructure to support the provision of public services and increase the investment attractiveness of territories.
- (5) Development of transport, engineering, social and security infrastructure.
- (6) Human capital development.
- (7) Promotion of entrepreneurship, support of business internationalization in the SME sector.
- (8) Support for innovation activities in municipalities.

## 5. Conclusions

Quantitative assessment of the sustainability of a municipality's socio-economic development has traditionally been based on a set of measurable indicators and indicators for regular monitoring of the situation. This approach provides an opportunity to identify missing areas of monitoring (rarely considered due to the complexity of the assessment procedure) that need to be monitored in order to achieve the overall goal of increasing sustainability. The authors used indicators and methods to assess socio-economic development and its sustainability, adapted to the statistical data in the framework of the developed monitoring mechanism. A system of indicators, including social and economic indicators, was developed to quantitatively assess the level of sustainable development of municipalities. The methodology used to assess sustainable development should take into account the basic principles of cluster methodology, i.e., it should be implemented taking into account the multiplier effects of inter-regional and inter-sectoral interaction.

Differentiated measures are needed for territories with different levels and potentials of socio-economic sustainability (for "strong" municipalities—stimulating measures, for problem and crisis ones—measures preventing their further degradation). The proposed approach to assessing the sustainability of socio-economic development of a region can be used for the purposes of regional governance, taking into account the Russian specifics of socio-economic development. The practical use of the obtained results can be implemented in the practice of regional management. The proposed integral assessment, considered in dynamics, can act as a criterion of regional social policy performance, as it covers the key factors of improving the conditions for human capital formation and development. It makes it possible to establish areas of responsibility (including personal responsibility) of regional authorities for improving assessment, and facilitates the development of concrete and targeted measures in this area from a systemic perspective.

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