

Analysis of the state of the urbanized landscape of the city of Tyumen

Marina Podkovyrova^{1,*} and *Dmitriy Kuchеров*¹

¹Industrial University of Tyumen, 625001, Tyumen, Russia

Abstract. The multifunctionality of the city makes it possible to consider it from the point of view of the urbanized landscape, giving due attention to the concept of its sustainable development. The development is based on the landscape-ecological approach, which makes it possible to analyze the natural, social, economic and urban planning subsystems of the city's land-property complex. This approach made it possible to assess natural and anthropogenic processes, to establish the degree of degradation of the urban landscape and, based on the method of analyzing hierarchies, the results of sociocultural surveys, to develop a set of measures for the rational organization of the use and protection of urban lands [1, 2, 5, 6, 7, 9-11].

1 Introduction

In the study of cities, its systems are primarily studied. And due to its uniqueness and versatility, the list of systems is gradually expanding. Socio-economic, dynamic, artificial, natural, urban planning, paradoxical and other systems are studied. What first of all makes you think about the fact that the existence and functioning of systems is provided, on the one hand, by the interconnection of subsystems, and on the other hand, by the development of these systems with each other. The urban system is characterized by elasticity due to a variety of functional connections both within and between subsystems. At the same time, as Lappo G. M. notes, "the city is a highly paradoxical system", which causes scientific interest in its assessment, analysis of its subsystems, their development, state, disequilibrium, disproportionality, ability to change, attitude to external factors and the possibility of transformation, and therefore the search for tools for their implementation.

Modern methods for assessing the land of cities deserve due attention. The scientific works of Russian scientists: Maslova N. V., Romma A. P., Roy O. M., Shigabieva G. N., etc. are devoted to the issues of assessment, sustainable development of land and property complexes of cities. Scientists note a special "purpose of evaluation" in the development of the concept, the choice of a strategy for the development of cities, as well as the forecast of the development of society and its territorial organization. However, it should be noted that they are mainly based on the position that reflects them as subjects of market relations. The integrated approach to the assessment includes a number of components and serves as the basis for compliance with the entire system of restrictions in the development and use of

* Corresponding author: podkovyrova.54@mail.ru

urban land, natural resources and the maximum desire to preserve the state of all components of the urban landscape. Ensuring optimal consumption and use of land properties within the city boundaries is possible when creating a system of ecological and landscape organization of the use of its land resources [1, 3, 4, 6, 8].

2 Materials and methods

The natural-territorial complex of the city of Tyumen, like many other cities, is formed and developed under the influence of historical, economic, social, landscape, and planning conditions, often losing or deteriorating the state of its key components, that is, natural components, thereby reducing the level of ecological and socio-economic sustainability of urban land use.

The purpose of complex analysis is as follows [1, 5-8, 10]:

1. Analysis of the current situation in urban land use and the organization of the use of urban land.
2. In establishing the level of the ecological state of the urban environment (for all components of the urban landscape).
3. In determining the degree of change in the urban landscape.
4. In identifying the causes of irrational land use.
5. In the development of a set of environmental measures.
6. Development of socio-economic recommendations for the formation of sustainable urban land use.

The comprehensive analysis includes:

1. Analysis of the development of territorial structures (by the factors that determine their state and trends of their change), changes in their relationships and the ability to meet the changing needs of society within the planning period.
2. Analysis of the interaction of factors that determine the development of territorial structures.
3. Analysis of the state of the components of the material environment of citizens (according to the factors that determine the trends of their changes), changes in their relationships and the ability to meet the changing needs of society within the planning period;
4. Analysis of the interaction of factors that determine the state of the components of the material environment.
5. Analysis of changes in the state and ability of each of the considered parts of the territory and their totality to meet the changing needs of society in its use within the planning period.
6. Development of a forecast for the further development of its natural and territorial complex.

The authors propose a methodology for assessing the variability of the natural-territorial complex of the studied territory on the basis of a typological approach. A comprehensive study of the variability and stability of the city's NTC was carried out according to the following factors [1- 3, 7-12]:

1. Ecological (level of air pollution, territorial differences in soil pollution and changes in the state of floodplain areas).
2. Social economic (level of variability: general parameters of a city, social economic activity in a city, consumption of resources, state of health of society, housing stock; level of development of the sphere of social, cultural and everyday services and transport support of urban areas) [6].
3. Urban planning (functional organization of the territory; the level of variation of the territory by architectural and aesthetic qualities and technical and economic indicators

characterizing the kind, type of construction and engineering arrangement of the territory of the city).

4. Landscape-aesthetic.

3 Results

When obtaining the average value of the assessment of the contribution of NTC variability to the integrated assessment of the state of the environment, calculated coefficients were introduced for each of the factors (formula 1):

$$D_i = \sum_{j=1}^n P_j \times \ln r_{ij}, \quad (1)$$

where P_j is the share of the territory with a certain level of variation of each of the environments in the average city with r_{ij} level of variation by the j - th factor.

The levels of variation of the NTC of the city of Tyumen are adopted in accordance with GOST 17.8.1.02-88 (ST COMECON 6005-87) «Nature Protection (SSOP). Landscapes and highly modified» set by accepted factors, for example (Figure 1).

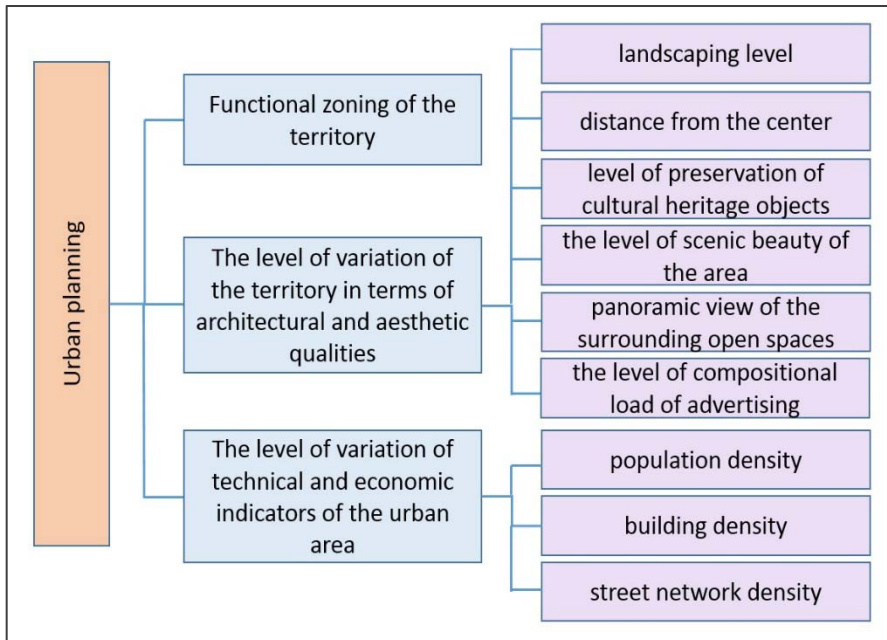


Fig. 1. Factors of urban planning assessment.

A comprehensive analysis of the ecological state of the city's territory included studies of the level of air pollution, soil, and the state of floodplain landscapes (Tables 9-12). The features of the ecological environment are related to the current system of functional organization of the city territory, as well as planning and construction solutions. When assessing air pollution, it is assumed that the environmental quality index (better quality corresponds to a higher index value) is associated with the environmental pollution index (greater pollution corresponds to a higher index value).

Maximum permissible concentrations (MPC) are accepted as criteria for environmental quality. Table 1 shows the MPC values for a number of atmospheric pollutants in order to perform the assessment.

Table 1. MPC value (mcg / m³) for long-term and short-term exposure.

Duration of exposure to the pollutant	suspended solids	sulfur dioxide	nitrogen dioxide	carbon monoxide	Photochemical oxidants (for ozone)
Long-term	50	50	40	3 * 10 ³	-
Short-term	500	500	85	5 * 10 ³	160

Environmental pollution indices are obtained:

1) when performing a quantitative comparison of the concentration of each pollutant with its standard (MPC), see formula 2:

$$A_i = \frac{C_i}{MPC_i}, \quad (2)$$

where A_i is the normalized value of the concentrations of the i -th pollutant according to its MPC;

C_i – measured concentration of the i -th pollutant in the environment;

MPC_i – maximum permissible concentration of the i -th pollutant;

Data on atmospheric air pollution in the city of Tyumen are provided by the Municipal State Institution "LesParkEconomy" (Table 2).

Table 2. Data on atmospheric air pollution in the city of Tyumen by planning areas.

The planning area under study	Average annual concentration of pollutants in the atmospheric air. mcg/m ³			
	suspended solids	sulfur dioxide	nitrogen dioxide	carbon monoxide
Central	0.04	0.04	0.03	1.5
Zarechny	0.01	0.02	0.02	0.7
MPC	0.05	0.05	0.04	1.8

Soil contamination with heavy metals is an urgent problem in planning for the sustainable development of urban land use. Sources of heavy metal pollution are: transport and road complex, industrial and municipal waste [3, 7]. The research is based on the materials of the results of the soil analysis of Shigabaeva G. N. [6]. The Zarechny planning area is characterized by the lowest degree of variation or the highest degree of stability (IV-100%), the Central Planning Area is characterized by the III and IV degrees of variation.

This article presents the results of the level of variation of the natural-territorial complex by technical and economic indicators and landscape-aesthetic conditions (Tables 3-4) [1, 3, 5, 6, 10].

Table 3. The level of variation of the NTC of the estimated planning areas of the city by landscape-aesthetic conditions.

Indicator	Evaluation score			
	Zarechny planning district		Tsentralny planning district	
	green area	residential area	green area	residential area
Landscaping level	5	4	3	2
Distance from the center	8	9	1	1
Cultural heritage preservation level	6	3	6	7
The level of terrain scenic beauty	3	5	8	6
Panorama of the surrounding open spaces	6	5	8	7

The level of compositional advertising load	10	9	5	4
The degree of NTC variability	II	II	II	III

Table 4. The level of the NTC variability of estimated planning districts of the city by technical and economic indicators.

Planning district	Indicator			Level of NTC variability
	population density, [people/ha]	development density (density factor)	density of the road network, [km/km ²]	
Zarechny	77.0	0.5	1.7	II
Tsentralny	111.0	0.7	2.8	III

In order to form the territorial model of the city of the most sustainable development, the method of thematic mapping was used (Tables 4). The zoning method was used to identify territorial differences in the established levels of variability and stability of the NTC of the planning areas of the city. An example of territory zoning based on the results of an environmental assessment is presented in the Figures 2 and 3.

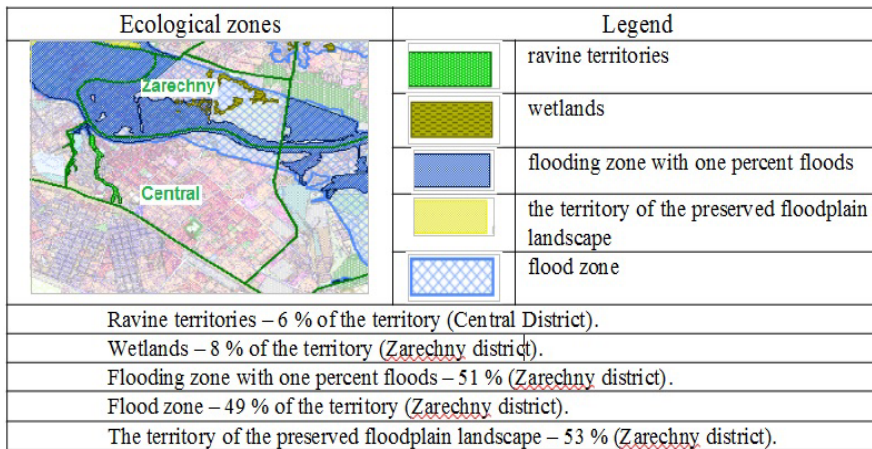


Fig. 2. Territories with the manifestation of negative physical-geographical and anthropogenic processes in the Central and Zarechny planning areas.

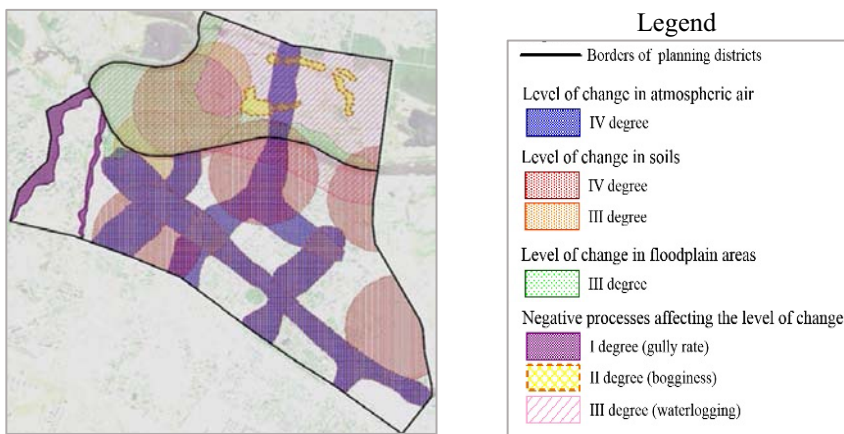


Fig. 3. The level of variability of the Central and Zarechny planning districts based on the results of environmental assessment.

As a result of the research conducted by the authors of the article, it was revealed that in the Zarechny and Central planning areas there were different levels of variability of the natural and territorial complex, the factors of influence were determined, as well as possible directions in the formation of the most sustainable development of the city.

4 Discussion

As for the comprehensive analysis of the city, including the analysis of the variability of the PTC, the problem of its sustainable development in our opinion is related to:

- a comprehensive understanding of the object (natural-territorial and urbanized landscape);
- the lack of a single information resource (SIR) that ensures the current functioning of the territory (complex), and as a result-the lack of a methodology for a comprehensive assessment (analysis) of land – basis (SIR), which requires a scientific and practical analysis of the current types of urban land use assessment and the development of all promising areas in this area.

Thus, the sustainable development of the city involves limiting the negative impacts on the environment, ensuring the rational use of natural resources and their protection, creating favorable and safe conditions for the life of the population [1, 2, 4, 8, 12].

5 Conclusion

The analysis of the level of stability of the NTC of the city of Tyumen determined that:

1. The central planning area as a historically developed city center is more likely to undergo changes in almost all components of the NTC.
2. The Zarechny planning district has the flexibility to plan the development of its territory, which will allow solving a number of problems of an urban nature.
3. There are possible options for improving the condition and preserving the unique floodplain areas of the city, which have undergone a number of changes due to the over-regulation of the river flow of water bodies, as well as the interspersed state in urban development.

In this connection, it is proposed to include the territories of the floodplain landscape in the system of the natural and ecological framework of the city of Tyumen with the subsequent creation of recreational zones on the sites adjacent to the citywide center; removal of dilapidated housing from the zone of floodplain landscapes and the creation of areal and linear green spaces; creation of a protected zone of the preserved floodplain landscape; preservation of the historically established compositional and spatial connection between the city center located on the high bank and the open panorama of the floodplain landscape [3].

Establishing the features of urban planning systems and the nature of their consideration in the formation of sustainable development, allowed the team of authors to propose and justify their own views and approaches to the assessment and planning of the most sustainable city, taking as a basis the position that the land of cities should be considered as an urbanized landscape based on a natural and territorial basis and representing a socio-ecological and economic system. This article describes the method of complex analysis, according to which the assessment and the level of variability of the natural-territorial complex of the city of Tyumen in the conditions of its urbanization was carried out, allowing to optimize the natural-economic systems, to model the urban real estate market [2, 3, 5, 11].

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