

# Comprehensive assessment of the state of the environment in rural and urban areas

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**Abstract.** The article examines the comfort of the environment in rural and urban areas. To assess the level of environmental comfort, methods were used to determine the degree of greening of populated areas, the state of tree plantations within green public areas, the aggressiveness of the visual environment and the quality index of the urban environment. Based on the results of the research, the comfort of the environment in rural and urban areas was compared and conclusions were drawn.

## 1 Introduction

Currently the quality of the human environment is one of the most pressing problems of any settlements located both in city and in rural areas. Not every settlement on the territory of the Russian Federation can fully meet the needs of its residents. At the same time, every resident of any locality in the Russian Federation has the right to comfortable and safe living conditions and must have all the necessary opportunities for it. These conditions include both the ecological state of individual areas and cities, as well as various aspects of the state, social and aesthetic nature [1-3].

All settlements represent a special type of landscape where there is a combination and interaction of natural and anthropogenic environmental factors. When designing territories for their lives and activities, people should first of all pay attention to the balanced distribution of anthropogenic factors affecting the natural environment. This is necessary in order to ensure the proper functioning of the urban landscape as a human habitat and the fulfillment of all its tasks to maintain a comfortable life for people on its territory.

Methods by which the quality of the human environment is assessed include assessment of individual components of the environment, as a rule, the degree of greening of the territory, since the ecological state of the city largely depends on the quality and quantity of green spaces, and a comprehensive assessment of the urban environment according to four main parameters: natural, social, environmental and geochemical [4-7].

Green spaces are an integral part of all modern urbanized areas, where objects of technogenic origin rather than natural ones predominate. Often in an urban environment, such a component of the natural environment as vegetation is displaced from the center and industrial zones to the peripheries of the settlement. This spatial distribution is also typical for the distribution of the population throughout the urban landscape, which is why people

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find themselves cut off from the natural environment. This entails not only psychological discomfort from constant presence in the technogenic environment, but also directly affects the deterioration of people's health, since vegetation is one of the most environmentally significant components of the human environment, the main function of which is to purify the atmospheric air from harmful impurities and gases.

Not so long ago in the Russian Federation they began to use methods for determining the quality of the urban environment in a complex, with the help of which it is possible to determine the numerical value of the quality of the urban environment of any settlement according to various indicators, including both environmental aspects of the urban environment and socio-economic ones.

An equally important problem is the quality of the visual environment where people live, which consists in its saturation with aggressive visual fields that have a direct impact on the state of the human nervous system through the load on the visual apparatus of the brain.

## 2 Materials and methods

The assessment of the degree of greening of territories is carried out by studying the structure of the system of green territories using cartographic materials and using the route-visual method, which make it possible to judge the parameter of the proportion of green territories in the total area of settlements - the level of greening.

According to sanitary norms and rules (SNIP 2.07.01.-89), the normative parameter of the proportion of green areas in general within settlements is 40%, and within the boundaries of populated areas with residential or mixed buildings – 25% (including the total area of all green areas of neighborhoods and blocks). Based on the data on the specific weight of landscaping facilities, it is possible to judge the availability of public landscaping facilities, which is measured in m<sup>2</sup> of landscaped territory per person.

The degree of negative impact on the environment can be assessed by assessing the condition of tree plantations on a 5-point scale, where: 1 point – trees without signs of damage; 2 points – trees with signs of weakening; 3 points – severely weakened trees; 4 points – trees with drying branches; 5 points – dry trees without leaves and needles. After determining the points of the condition of individual trees in the study area, the average score of the state of tree plantations is calculated in the study area.

According to the calculation results, a status category is assigned to tree plantations, determined by the following numerical ranges:

- $K < 1.5$  – healthy.
- $1.6 < K < 2.5$  – weak.
- $2.6 < K < 3.5$  – very weak.
- $3.6 < K < 4.5$  – shrinking.
- $K > 4.6$  – dead.

To determine the aggressiveness index of the visual environment of any visual field, the method of calculating the aggressiveness coefficient developed by S. I. Fedosova is used, with the help of which it is possible to assess the aggressiveness of any landscape by its photographic image. To perform research using this technique, it is necessary to apply a grid to a photograph of the object under study, the size of which is determined in accordance with the calculation of the angular dimensions of the photographic image, and then calculate the aggressiveness coefficient of the grid, equal to the ratio of the number of elements to the total size of the grid cell.

The aggressiveness coefficient of the visual environment ranges from 0 to 1. When the coefficient values increase to 1, the aggressiveness of the visual environment increases, and the location of its value closer to 0 indicates that the visual environment is non-aggressive.

Quantitative determination of the quality of the urban environment is carried out according to the methodology for the formation of the urban environment quality index, which was approved by the Decree of the Government of the Russian Federation dated 03/23/2019 No. 510-r "On approval of the methodology of the formation of the urban environment quality index". In accordance with this methodology, the urban environment quality index is measured in points and is a numerical expression of the state of the urban environment and its provision with the benefits necessary for human habitation, obtained as a result of a comprehensive assessment of parameters having quantitative expression. Parameters characterize a set of conditions that determine the level of comfort of living in the relevant locality. The index is calculated based on the sum of the values in the scores of 36 parameters, with the help of which the quality of the urban environment is also assessed according to 6 criteria. The criteria of the urban environment quality index are safety, comfort, environmental friendliness, diversity, modernity and efficiency, which are analyzed in residential space, street and road network, degree of landscaping, availability of social and leisure infrastructure, citywide space. Each of the 36 parameters is evaluated on a 10-point scale, where 1 point means the minimum value corresponding to the unfavorable state of the characteristics of the urban environment considered within a certain parameter, and 10 points – the maximum value. If the total score for 36 indices is less than 180, the quality of the urban environment is considered unfavorable, more than 180 is favorable [8-12].

### **3 Results**

The research was carried out in rural areas, for which the locality was chosen – the stanitsa Maryanskaya, as well as in urban areas on the territory of Krasnodar. Areas with low-rise residential buildings on land plots for individual housing construction were selected for research.

As a result of studying the structure of the system of landscaped areas of the stanitsa Maryanskaya, it was revealed that the provision of public landscaping facilities in the study area is 14.7 m<sup>2</sup>/person, which corresponds to the standard for rural settlements. The level of total landscaping in the research area, including limited-use landscaping facilities (private landscaped areas, landscaping on the territory of enterprises) and special-purpose landscaping facilities, amounted to 33.6%, which corresponds to the regulatory requirement for rural settlements.

For the research area in Krasnodar, the provision of public landscaping facilities amounted to 8.4 m<sup>2</sup>/person, which is a fairly low parameter, provided the location of the study area within an urban area with busy traffic. The level of total landscaping in the research area, including limited-use landscaping facilities in Krasnodar, amounted to 45.4%, which corresponds to the regulatory requirement for urban settlements.

The assessment of the condition of tree plantations was carried out within the green areas of common use located in the study areas. According to the results of this work, the coefficients of the state of tree plantations represented in the territory of the research area in the stanitsa Maryanskaya by the species of holly maple, heart-shaped linden, squat elm and common pine were determined, and in the territory of the research area in Krasnodar – platan-leaf maple, small-leaved linden, warty birch, Crimean pine and horse chestnut. For the research area in the stanitsa Maryanskaya, the coefficient of the state of the stand was 1.5, which corresponds to the category of a healthy stand. The most weakened tree species turned out to be the holly maple. For the research area in Krasnodar, the coefficient was 2.1, which belongs to the category of weakened stands, the most weakened type of tree plantations of which was the warty birch.

The obtained parameters of the state of tree plantations in rural and urban areas indicate that in urban areas on the territory of Krasnodar, the environment is more polluted than in rural areas on the territory of the stanitsa Maryanskaya.

To assess the quality of the visual environment in the research areas, 5 viewpoints were selected on the routes of the most intense pedestrian traffic, in which photographs were taken for further grid overlay and calculation of the aggressiveness coefficient.

In accordance with the calculated data, grids were superimposed on the photos using the GIMP graphics editor. The result of the grid overlay on the example of one photo is shown in Figure 1.



**Fig. 1.** Photo with a grid.

After that, for each photo image, the number of grid cells was determined, in which there are several (more than two) identical viewpoints. The study of photographs with superimposed grids revealed that the coefficient of aggressiveness of the visual environment, in five selected viewpoints, in the research area in rural areas totaled 0.13, therefore, the visual environment is non-aggressive. On the territory of the research area in Krasnodar, the calculated index of the aggressiveness coefficient for 5 selected viewpoints was 0.24, which is a higher parameter of the aggressiveness of the visual environment compared to the obtained parameter for rural areas, but the value obtained is still insignificant.

As a result of determining the index of the quality of the urban environment of the studied area, on the territory of the stanitsa Maryanskaya the index was 146 points, therefore, the urban environment of the studied area is unfavorable. At the same time, such criteria as safety (42 b), environmental friendliness (33.5 b) and comfort (26.5 b) have the highest indicators, and efficiency (20 b), modernity (13 b) and diversity (11 b) have the lowest indicators. Of the 6 evaluated types of spaces, citywide space has the highest indicators (36 points) and the street and road network (31.5 points), the rest are at a low level.

For the study area in Krasnodar, the urban environment quality index was 177 points, which also indicates an unfavorable urban environment of the studied area. The highest indicators have criteria such as safety (44 b), efficiency (38 b) and comfort (31.5 b) and the lowest – environmental friendliness (26 b), diversity (22.5 b) and modernity (18 b). The citywide space (43 b) and the street and road network (35 b) have the highest indicators out of the 6 assessed urban spaces. The remaining indicators are in the range of 20-30 points.

## 4 Discussion

Modern cities and towns must meet the modern needs of their residents. Every resident of any locality in the Russian Federation has the right to comfortable and safe living conditions and must have all the necessary opportunities for it. In this work, a comprehensive study of the comfort of the living environment of people was conducted on the example of areas with low-rise residential buildings on the territory of the stanitsa Maryanskaya and Krasnodar city. As part of the study, a comparison of the level of comfort of the environment in rural and urban areas was carried out, as a result of which the main disadvantages and advantages of the considered types of populated areas were identified.

## 5 Conclusion

Thus, based on the analysis of the data obtained during the study, the following conclusions were drawn:

- The proportion of green areas is higher in the territory of the studied area in Krasnodar, however, the provision of green areas for public use is higher in the studied area on the territory of the stanitsa Maryanskaya.
- The condition of tree plantations within the green areas of common use is better in the territory of the studied area in the stanitsa Maryanskaya, which indicates a less polluted environment.
- The quality of the visual environment, assessed by the coefficient of aggressiveness, turned out to be higher in rural areas.
- The quality of the urban environment, based on the calculation using the methodology of forming the urban environment quality index, turned out to be higher in the territory of the studied area in the territory of Krasnodar.

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