

## DEVELOPMENT OF THE NATURAL ENVIRONMENT OF THE TERRITORY OF KAZAN: MATERIALS FOR ENVIRONMENTAL-HISTORICAL ANALYSIS

<sup>a</sup>RENAT I.ZAMALETDINOV, <sup>b</sup>IRSHAT S. SHIGAPOV,  
<sup>c</sup>ALEKSANDER V. NIKITIN, <sup>d</sup>MARIA A.KOSHMAN,  
<sup>e</sup>LYASAN Z. SULTANOVA

<sup>a</sup> Kazan Federal University, The Institute of Management, Economics and Finance, Department of Environmental Engineering and Water Management, Kazan, 420008, Russia

<sup>b</sup>Kazan Federal University, The Institute of Management, Economics and Finance, Department of Environmental Engineering and Water Management, Kazan, 420008, Russia

<sup>c</sup> Kazan Federal University, The Institute of Management, Economics and Finance, Department of Environmental Engineering and Water Management, Kazan, 420008, Russia

<sup>d</sup> Kazan Federal University, The Institute of Management, Economics and Finance, Department of Environmental Engineering and Water Management, Kazan, 420008, Russia

<sup>e</sup>Kazan Federal University, The Institute of Management, Economics and Finance, Department of Environmental Engineering and Water Management, Kazan, 420008, Russia

email: <sup>a</sup>i.ricinus@rambler.ru, <sup>b</sup>Rusia@Prescopus.Com,  
<sup>c</sup>a.v.nikitin2015@gmail.com, <sup>d</sup>m.a.koshman2015@gmail.com,  
<sup>e</sup>l.z.sultanova2016@gmail.com

**Abstract.** The process of formation and development of urbanized areas is of great interest as from the position of history, as from the position of ecology and rational nature management. This article presents data on the historical development of the territory of a large industrial city (Kazan, Russia). The conducted research showed, that according to the type of spatial development, the territory of Kazan belonged to the cities with a mixed type of development. The basis for the urban structure of gardening was the preserved natural parts of the city, however, during the historical development of the city, the relative area of gardening has been decreased, the vegetation has been deteriorated. This led to a violation of the spatial relationships between the anthropogenic and natural component of the urban environment. At the same time, within the city limits, there are some areas, which can be used as elements of an ecological framework.

**Keywords:** dynamics of urban development, urbanization, ecological framework of the city.

### 1 Introduction

The study of the dynamics of natural conditions is an important aspect as for fundamental researches, as for the implementation of application activities. The study of urbanized areas is of particular interest.

Currently, several approaches to this problem are generally accepted. All of them ultimately reflect the spatiotemporal heterogeneity of the urban area, in terms of the degree of environmental anthropogenic transformation. However, the role and the place of city in the history of environmental development are still rather vague. The study of the urban environment, as a result of natural landscapes development, was not only put on the periphery of ecological history, but also was forced into the sphere of urban history and the history of technology (Melosi, 1993). Studies, dedicated to the role of anthropogenesis in the development of landscapes, rarely consider the city as a separate object.

The application of the historical-ecological approach in studying the issue of the development of natural conditions within the limits of the city allows us to reach a completely new level of studying the problem (Kalimullin, 2015; Kalimullin, 2015).

An adequate assessment of the urban development dynamics gives a clear idea of the ways and mechanisms of micro-

evolutionary processes in populations of living organisms. Based on these data, there is the possibility of objective assessment of the negative impact of urbanization on human health. In application aspect, the study of the dynamics of urban areas transformation allows the effective planning of measures to maintain a stable and prosperous state of the urban area.

The main purpose of this work is to conduct a general assessment of the development of natural environment of a large city (on the example of Kazan) from the perspective of the possible use of preserved territories to form an ecological framework.

The work was carried out at the Department of Environmental Engineering and Water Management of the Institute of Management, Economics and Finance of Kazan (Volga) Federal University.

### 2 Materials And Methods

The dynamics of change in the ratio of separate parts of the urban territory was analyzed in this paper. The following documents were used as a topographic basis for vectorization:

- map of Kazan with environs of the Kvanin technique - 1879;
- map of Kazan from the guide of Perevoshchikov - 1913;
- map of Kazan - 1939;
- scheme of passenger transport in Kazan - 1988;
- general plan of Kazan. Principal drawing – 2017.

Topographic foundations were associated to the terrain according to the coordinates of the preserved historical buildings, and were vectorized manually in the QGIS 2.18 software package. The maps were generalized by the 4 types of objects:

- water objects;
- areas with trees and shrubs vegetation (green areas of the city and the suburbs);
- built-up areas;
- unfinished areas.

The boundaries of the urban settlement were identified according to the boundaries of the city line, indicated on the maps, in case of its absence – according to natural borders (river banks, forest borders, etc.)

The data obtained were processed by general mathematical methods.

### 3 Results And Discussion

The process of urban areas development in most cases is uneven. Often this conclusion follows from an analysis of literary data on the change in the area and population of cities or on the rate of development of a particular sphere of life in the city (Kalimullin, 2015; Kalimullin, 2015). According to the results of our study, the rates of growth of Kazan territory varied from 4.3% per year (from 1939 to 1988) to 24.2% per year (from 1913 to 1939). Such sharp, more than six-fold increase in the area from 30.7 km<sup>2</sup>, up to 193.2 km<sup>2</sup> (see the Table) is connected with the inclusion of several settlements in the city line. At the same time, the rural nature of these settlements led to 25-fold increase in the area of green zone.

Table 1. Dynamics of changes in the area of separate parts of Kazan environment in, km<sup>2</sup>

Year	Water objects	Green area of the city and the suburbs	Built-up areas	Unfinished areas	Total area
1879	0,73	2,54	10,62	7,36	20,58

1913	1,26	0,58	21,75	7,14	30,73
1939	6,84	14,92	42,9	128,5	193,16
1988	17,54	81,62	217,99	92,88	410,03
2017	21,77	178,42	547,71	236,77	984,67

It should be noted, that the analyzed materials do not allow to estimate with sufficient accuracy the dynamics of the areas of separate parts until 1879, this issue is the subject of further researches. However, the above data allow us to identify the trend to the increase in the area of all parts. This is an objective reflection of general trends of the city's growth. And it allows us to state, that the city of Kazan belongs to cities with a mixed type

of development, according to the type of spatial development of the territory.

It is more obvious to consider the dynamics of ratio of relative areas of the city environment elements. The figure presents the dynamics of the ratio of separate parts of environment in Kazan.

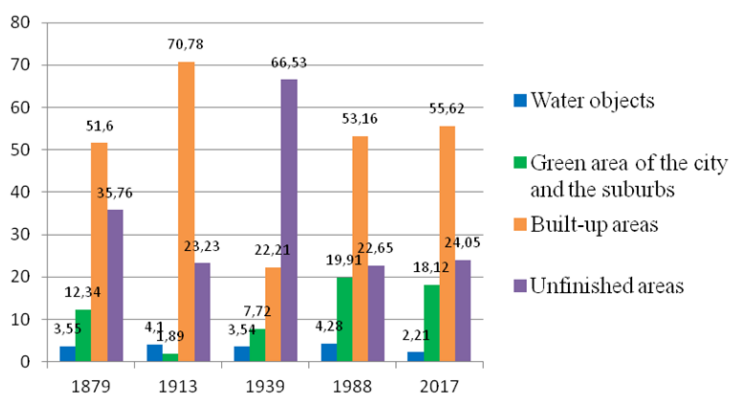


Figure 1. Dynamics of the ratio of separate parts of the environment in Kazan, %

Traditional ideas about the changes in the natural environment of cities are connected with a decrease in the area of green zones. However, the analysis of our data does not support this assertion. Moreover, there is an increase in the relative area of green zones from 1.89% (1913) to 19.91% (1988).

Such great increase can not be considered unequivocally. Since the beginning of the XVIII century, intensive deforestation begun due to the construction of Russian fleet, the construction of fortresses and cities. By the first half of the XIX century about 50% of the forests had been cut in the region, by the beginning of the XX century - more than 70%. At the same time, the most part of wood logging fell to the share of suburban forests, due to the proximity to the consumer. On the places of felling, new plant communities grew, most often from less valuable species. As a result, the quality of green zones deteriorated, but their relative area increased.

At the beginning of the twentieth century, the development of the concepts of urbanism and dezurbanizm entailed a general change in the organization of the city natural environment: an increase in the area of greening and the formation of planning methods for organizing the planting of greenery throughout the city. The nature of the formation of small green spaces in the second half of the XX century (Novikova, Yupina, 2012) was determined by the period of development of territories for residential construction.

In the areas of mid-rise buildings, developed in the 40-60's of the XX century, the landscape component was characterized by the advanced background gardening of residential yards, greening of streets and pedestrian routes to the centers of attraction, elaborated placement of nodal elements of small landscaping, located along the main transport and pedestrian communication (street). In the areas of Dekabristov Street, Kopylova Street, Frunze Street, Krasnokokshayskaya Street, Sibirskiy Tract, the prerequisites for linear-node systems of small landscaping objects were formed: gardens, squares, boulevards, combined with well-maintained pedestrian routes.

In the 1980s, the theoretical basis of the common structural organization for greening cities on the basis of belts, rays, wedges, etc. was formed. At the same time, the nature of planning activities for gardening was strictly regulated by the condition and availability of the city's general plan. Landscaping of the urban environment became an important factor for the development of the city, and at the same time, an indicator of the conditions of its comfort.

In the areas of modern large-scale development, which was established in the 70-90's, the projects provided for green areas at all levels of the structural hierarchy. So, according to the norms, in residential areas, along with background gardening of residential groups, district and micro-district gardens with a minimum area of 3 ha and the radius of access of no more than 1.5 km should be allocated. However, for the most part, not all of the design solutions for forming the greening system in the residential areas of Kazan were realized (the boulevard on Absalyamova Street, the preserved natural objects in the structure of development - forest belts, lakes within the residential building of Gorki, East and West Zarechie).

According to our data, water objects have undergone the greatest transformations. There has been a gradual decrease in the share of water bodies from 3.55% in 1897 to 2.21% at the present time.

The fact is that in the XIX century, the territory around the Kaban lakes was undergone significant changes. The forests were cut down, wetlands were covered, and the coast was built up. The shores of the Kaban lakes were planned, the area of the lake was reduced, the stream tributaries and springs were not functioned.

In the XX century the most significant event was the creation of the Kuibyshev Reservoir. As a result, the hydrological characteristics of a number of water bodies changed. The situation has become especially aggravated since the 1970s, when the territories in the Zarechnaya part of the city (in particular in the Novo-Savinovskiy district of Kazan) were

developed for housing construction, more than 30% of small lakes disappeared during the last 10 years. This tendency is also observed at the present time (Mingazova, 1989; Shigapov, 2014; Mingazova et al, 2015).

Most of the territory of Kazan now is the built-up area, primarily habitable territories. The fastest growth of urban development began from the end of the XX century. This historical period is characterized by the active development of internal spaces (including the crowding of existing buildings). In this regard, many landscaped territories, land plots within water protection zones, water bodies became the part of the development area.

Since the second half of the 1990s till the present time, the cases of building in urban natural areas have become more frequent: parts of city parks, water protection and coastal zones of the Volga River, the Kazanka River, lakes and small rivers have been built up. There is a massive cutting down of trees and the reduction in the area of greenery.

Thus, at present time, the territory of Kazan is characterized by the problem of insufficient quality and landscaping area in the center of the city, for the formation of comfortable urban environment. Peripheral territories have significant areas of green spaces, forming by housing estates, private sector, dachas. However, there is a lack of equipped green spaces, which are open public spaces, allowing citizens to spend their free time, do walking, go in for sports outdoors, etc.

#### 4 Conclusion

The results, presented in this paper, show that for more than 1000 years of history, the territory of Kazan has increased many times. According to the type of spatial development, the territory of Kazan belongs to the cities with a mixed type. Expansion of the city's territory was accompanied by uneven development. As a result, up to now, some areas have been preserved within the city limits, which can be characterized as possible elements for the formation of ecological framework.

#### 5 Deductions

The analysis of the current state of Kazan natural environment showed, that the area of greening in the city did not change significantly. However, the form of gardening changed significantly, the vegetation conditions deteriorated. All this leads to the violation of spatial relationships of the anthropogenic and natural components of the historical environment. Such changes in some cases may have irreversible consequences in the form of complete or partial degradation of the territory.

A few preserved natural areas of the city served as the basis for the urban structure of gardening. For example, one of the oldest parks of the city - the Central Park named after M. Gorky ("Russkaya Shveitsariya") and specially protected natural reservation "Nemetskaya Shveitsariya" for a long period of time was an element of the ecological framework, having preserved the elements of forest-steppe vegetation (Burova, 2011; Ismagilova, Gataullina, 2014; Nikitin, 2010).

The state and peculiarities of functioning of the historically developed spatial environment, taking into account the formation of gardening, were shown in this paper, on the example of Kazan. Formation of new elements of gardening within the

framework of the reorganization of the existing one (on the example of Kazan) is aimed to optimization the functioning of spaces, to improve the state of comfort, to emphasize the structure-forming axes and nodes, to enrich the image of the environment, and, on the whole, is focused on maintaining relative ecological balance. Landscaping of the urban environment becomes an important factor of the city development and, at the same time, is an indicator of its comfort conditions (Mingazova, 2015).

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