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Green Framework and Its Role in Sustainable City Development (by Example of Yekaterinburg)

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Abstract. The article focuses on the destruction of the city green framework in Yekaterinburg. The strategy of its recovery by means of a bioactive core represented by a botanic garden has been proposed. The analytical framework for modification in the proportion of green territories and the total city area has been described.

1. Introduction

B In the past centuries, a place for a settlement used to be thoroughly chosen through examination of its strategic location and natural resources. Over time, such settlements developed, and while some of them stayed small, others were abandoned by their citizens, and some grew into megapolises occupying vast territories that continue their development. Some distinguished architects and sociologists such as F. L.Wright or L.Wirth believe that the city growth is something self-evident, a normal state of things, a modern necessity [1,2]. Indeed, people needed jobs and accommodation, traffic developed, then high-rise construction appeared. The cities, during their growth, reclaimed different wild territories. Nowadays, construction is under prohibition on some of such territories. First of all, there are lands unsuitable for human activities. Secondly, there are certain corners of the world that are under environmental protection [3]. This means that our knowledge about urbanization process is very limited and requires more detailed studies. One more important issue is detachment of a human being from the organic nature. When a human being lives in urban environment, he starts feeling the need to communicate with nature. Modern ecological situation requires reexamination of techniques and methods of dealing with green framework. Many countries are in active search of the way out of this situation. For example, Danish architect Jan Gehl has developed an urban environment design strategy and defined main purposes of its development [4]:

- The lively city.
- The safe city.
- The sustainable city.
- The healthy city.

His strategy has been successfully implemented and yields substantial results in improving human environment, especially as modern technological advance creates new materials that allow building constructions of a new type that are open to interaction with the environment and expand the activities of the citizens [5].

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Russia, as the majority of other countries, is steering a policy of the living environment improvement. The respective program *Strategy-2020* has been developed as solution of any practical issues primarily depends on social order [6,7].

Sustainable development of the territory means that urban development protocols imply provision of safety and favourable conditions of human activities, limitation of adverse influence of commercial and any other form of human activity on the environment, provision of environmental engineering and efficient use of natural resources for the sake of living and future generations [8].

To sustain city development, we can distinguish four groups of factors. These are

- Ecological factors.
- Urban development factors.
- Economic factors.
- Social factors

These groups are interconnected and form a single urbanization pattern [9].

2. YEKATERINBURG. Current state of urban vegetation system.

Certain ecological problems do arise in the process of city formation, which can be illustrated with the example of Yekaterinburg. Nowadays, Yekaterinburg is a post-industrial million plus city. As the majority of the cities in the world, it formed around a plant, and this requires preserving its image, creating conditions for its sustainable development with due regard to modern intense level of construction activities. Sustainable development of such a city requires restoration of its vegetation and implies elaboration of scenario planning for its main sectors. To determine positive and negative sides of current state of the city regions, we must examine city development trends, distinguish its peculiarities and possible development pattern aimed at improvement of human well-being.

To analyze current vegetation state of Yekaterinburg, we applied a graphical analytic method that implies graphical outlining of green territories at different phases of the city development and their comparison with further description of the identified changes. To perform the analysis, we have taken city plans of different years of its development, i.e. 1856, 1932 (pre-war period), 1947 (post-war period) and 2015 (see Figure 1). Comparative analysis of these plans showed active development of the city territory during the war. It is attributed to quick development of industry, primarily in the military segment. It can be noted that this growth insignificantly slowed down during the post-war period. The plans also demonstrate that the city was surrounded by vegetation, though the central part of the city practically lacks greenery [10]. It is important to point out that this fact is typical of big cities. L.Wirth highlightens it in his book *Urbanism as a Way of Life*. He distinguishes several city zones. The core of the city is its commercial centre, then comes the so-called zone of transition, working class residences, multi-dwelling regions, city zone and suburbs [2]. Yekaterinburg goes through the same stages of development.

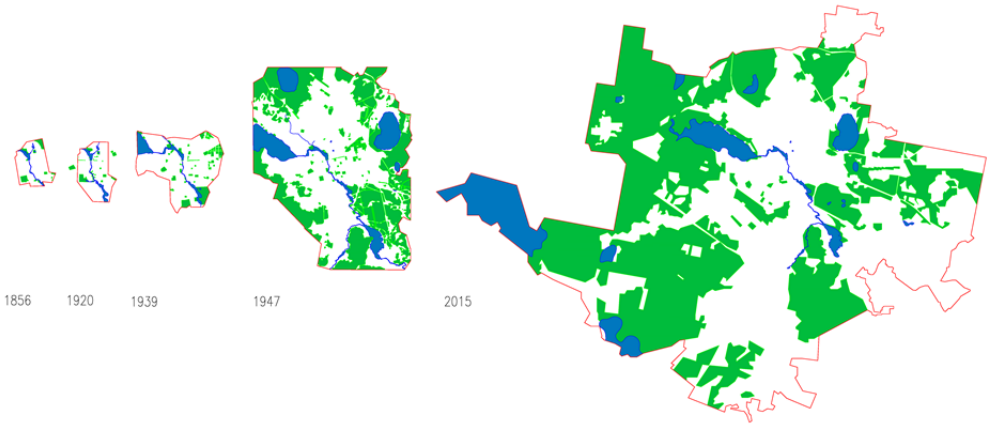


Figure 1. Pattern of the city changes in different years.

Then we turned out attention to the central part of the city, i.e. the historical centre where the city started its development. We have studied the phases of the city development, compared planning solutions as of 1947 and 2015 (see Figure 2). It was calculated that in 1947 this territory included 109.3 ha of greenery, but in 2015 it diminished to only 75 ha. This means gradual destruction of the green city framework that occurs due to the influence of the following factors [11,12]:

- Constant increase in anthropogenic load.
- Lack of land use planning and management.
- Unstable economic development.

All these above-mentioned factors lead to deterioration of the human environment.

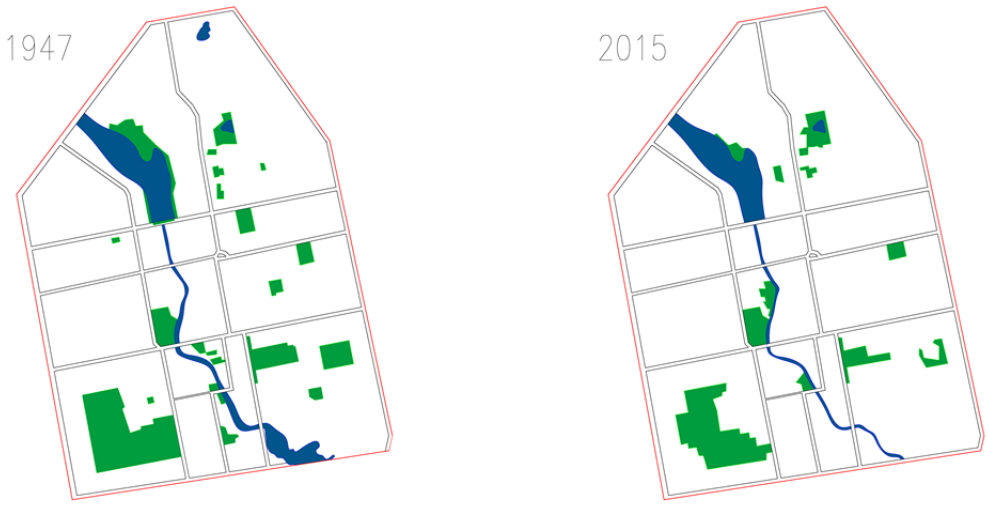


Figure 2. Greenery pattern of the city centre from 1947 to 2015 (Yekaterinburg).

3. Strategy of greenery restoration.

To solve the issue of improving city environment, we suggest a greenery restoration method based on introduction of stable bioactive cores of urban vegetation system. These cores are aimed at creation of healthy and comfortable environment due to formation of local biocenosis introduced into the structure of housing development, being a special biological mechanism for restoration and maintenance of city the infrastructure (the term was introduced by J. Todd). Bioactive core consists of the following elements: biological ponds, water passages, lagoons, forest skirts, meadows and pathways [13]. One of the main components of these elements is vegetation, i.e. trees, shrubs, aquatic vegetation, grasses, etc.

Research of biological active cores, biological filters and other biotechnologies is currently under way [14-16]. We believe that botanic gardens should be considered as such a core, and this is the novelty of this analysis. This unique object has a strong scientific potential and can offer a large amount of resources for creation of vegetation being more resistant to anthropogenic loads and adapted to different areas of the country. For example, Botanic Garden of the Ural branch of the Russian Academy of Sciences, Yekaterinburg has six laboratories fitted with state-of-the-art equipment and is proud to present an impressive collection of woody and herbaceous plants consisting of about 4 thousand taxa (species, subvarieties, forms and varieties) [17]. There is also another unique resource, i.e. the so-called *gene banks* that preserve sprouts and seeds of plants, including endangered plant species. It must be noted that a lot of Russian botanic gardens are research institutions.

4. Conclusion.

Thus, we suggest a framework for the development of the city network of bioactive cores and introduce the Botanic Garden of the Ural branch of the Russian Academy of Sciences (Yekaterinburg)

as one of such cores. A new landscaping approach is also required. This implies reexamination of historical role of botanic gardens, their social and economic position. Such measures will allow restoring green framework of the city territories and improving the quality of life for the citizens.

References:

[1] Lloyd W 2016 *The Disappearing City* (Moscow: Strelka Press) p 180
[2] Wirt L 2016 *Urbanism as way of life* (Moscow: Strelka Press) p 108
[3] Podoinitsyna D, Khomyakov D and Gladova P 2016 Infrastructure approach to forming a green areas system of green-urban super system *Science* vol 8 **6** 92
[4] Gehl J 2012 *Cities for people* (Moscow: KROST) p 276
[5] Chulkova E and Moor V 2014 *The 6ht Int. Sc. Conf. The New Ideas of New Century* vol 2, ed V I Luchkova and E M Samsonova et al (Khabarovsk: PNU) pp 260–267
[6] Pimenova G and Koptyaev D 2014 The formation of green city *Science and the world* **8(12)** pp 64–66
[7] Shaykhramov A 2015 Principles of organization of the green skeleton in the structure *Int. Scientific Research Journal* **5-3(36)** 110
[8] Krasnoshchokova N 2010 *Formation of a natural framework in the general plans of cities* (Moscow: Arkhitektura-S) p 184
[9] Vagin V, Sheina S and Chubarova K 2015 Principles and factors of sustainable development of territories *Science* vol 7 **3(2015)** 9
[10] Srodnikh T 2009 Formation of system gardening of city Ekaterinburg *Forests of Russia and their economies* **3-34** pp 48–53
[11] Podoinitsyna D and Baymuratova S 2016 The current state of the green areas system of the largest cities in Russia *Arkhiort* **1(3)** pp 29–37
[12] Prokopenko V and Kositsyna E 2014 *Int. Sc. and Tech. Conf. Engineering-ecological problems of the construction complex of the region* ed A N Bogomolov and T K Akchurin et al (Volgograd: VSUACE) pp 173–179
[13] Sadkovskaya O 2011 Ecological clusters as a tool for better urban environment (based on the study of small and average towns along with the regional centers of rural administrations of Russian south region) *Architecture and modern information technologies* **4(17)** 12
[14] Kolyasnikov V 2014 *Int. Res. Conf. Architecture and Quality of Life of Urban Populations* ed S P Postnikov and M V Puchkov et al (Ekaterinburg: USAAA) pp 13–18
[15] Merenkov A and Yankovskaya Y 2017 *The 17ht Int. Res. Conf. The New Ideas of New Century* vol 1, ed V I Luchkova and L G D'yachkova et al (Khabarovsk: PNU) pp 291–296
[16] Popova S, Baimuratova S and Selezneva E 2015 Modern experience of formation of city gardening systems *Arkhiort* vol 1 **2** pp 44–51
[17] Russian Academy of Sciences, Ural Branch: Institute Botanic Garden (Yekaterinburg) Retrieved from http://botgard.uran.ru