Methodological aspect of landscape and ecological reconstruction of Green ring around Volgograd (Stalingrad)

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Abstract. The research is intended for the model development of the external Green ring of the town forming the barrier from the negative natural and climatic phenomena with the purpose to ensure a comfortable sphere of the internal living space. The paper present new landscape decisions increasing the potential of the berry and fruit species assortment of the new species-varietal zoning. The authors analyze the history of forming the Green ring of Volgograd (Stalingrad) from the perspective of the urbanized forestry science. The main methods used in the research are: the method of system analysis; modeling and experimental design. The methodology is based on the modeling and designing plantings of the various functional purposes, taking into consideration the current trends in the urban science landscape design. The developed methodology of a new construction and reconstruction of the green ring can be used in the domestic and in the foreign design in the similar environmental conditions. The analysis of the experience of a green ring forming allowed one to re-evaluate the landscape and the ecological solutions in organizing a comfortable town environment. The experimental design was supported by the developed model of the Green ring of the town.

1. Introduction
The world practice of the urban design accumulated a considerable experience as for the issues of development of the landscape and ecological technologies of the external green rings forming of the towns, in particular the directions for improving the sylviculture. The interest is in the use of the landscape solutions as a means of ensuring the health of residents, the biodiversity and the quality improving of the environment in the sparsely wooded regions, the possibility of developing the recreation here. As for the regions with a severely arid climate, to which Volgograd belongs, the creation of the comfortable living conditions becomes an important landscape event, where the forest building plays an active role. The planting of the greenery techniques (the interchange of areas of the forest crops with the orchards, the enrichment of the species composition) in the landscape of the green ring are aimed at creating of the favorable conditions for the recreational forest use and a comfortable environment of the urban structures.

1.1. Tasks of research
The aim of research is the rationalization of the regional features of the landscape solutions for the construction and the reconstruction of the external green ring of the town.

Tasks of research:
1.2. Practical and theoretical base of work
The concept of the idea of developing the external green rings of the towns is becoming one of the most discussed topics by the professional architectural and engineering community and is connected with the research on the design of the greenery planting systems and a comfortable urban environment. [1-4]; on the selection of constructions and a range of woody plants and their multifunctional role[5,6]. It is mentioned that the green areas support the achievement of the ecological comfort in the town, the formation of the urban planning strategy which preserves the local context and the architectural traditions. [7, 8]. The authors, analyzing the existing layouts, show that the green rings act as a vector of the further social-economic development. [9-11]; the research conducted by L.P. Rysin, V.S. Teodoronskii, L.I.is the evidence that the green zones should be designed as the living organisms with the help of the individual methods [12-14]. This principle is applied in a creation of the regional forest park zones and the green rings, as well as in the approving of the new technologies. [15, 16].

The analysis of development of the external green ring on the example of Volgograd reveals an important role of the forest plantations in ensuring the sustainable development of the town, performing a variety of the environmental, protective, sanitary and hygienic as well as the recreational functions[17-20].

2. The method ‘Estimation of the degree of environmental sustainability and the landscape attractiveness’

2.1. Determination of the systematic condition of the landscape according to the level of stability
In accordance with the methodology [20] there was carried out the estimation of the degree of the environmental sustainability and the landscape attractiveness of Volgograd town forest division and there were determined the coefficients CESL₁ and CESL₂ [11] (coefficient of ecological stability of the landscape).

The coefficient CESL₁ is based on a comparison of the areas occupied with the different landscapes; the coefficient CESL₂ estimates the landscape, taking into consideration the influence of its biotic elements, their internal properties and qualitative condition. There was found out with the help of the calculations that the value of the coefficient CESL₁ is −3.46 (the evidence of a well-defined landscape stability); the value of the coefficient CESL₂ is 0.1 and characterizes the territories as unstable. The development of a complex of measures concerning the increase of the stability of biotic elements will allow the rational use of the landscape and will prevent the possible loss of the forest areas [21].

2.2. Determination of the landscape condition by the level of decoration
The assessment of the green ring plantations indicates that they have a low decorative effect, poorly perform the sanitary and the hygienic functions and are extremely unstable. The condition of the areas of the enclosed spaces is worse than half-open and is estimated at 40-50 points (IV level of digression).

The plantations have a monotonous species composition (with a predominance of monocultures) and the structures (forest belts and massifs), created only to stabilize and to prevent the destruction of the soil. In connection with the addition of the recreation function, the biodiversity preservation, the improvement of microclimate and the composition of the atmospheric air, the formation of the green ring is based on the distinguishing of the different types of spaces, including the tree species of the
various categories in the plantations with the purpose to improve the aesthetics and the landscape diversity of compositions.

3. Development of the experimental part

3.1. Natural and climatic potential of the area

The lands of Volgograd region situated on the south-east of Russia are presented by the main natural zones (chernozemic prairie, dry prairie and semi-desert). In some years the severe droughts, the dry winds and the dust storms were observed along with the general aridity of the climate. The insufficient humidity, the presence of significant areas of the sands and the sandy soils (the massif of Archedinsk-Don sands, the bench sands of Don, Volga region sand belts) - create great difficulties in the selection and cultivation of the tree species. In 1948 the works on the blown sands stabilization showed the perspective of using the tree vegetation in order to stabilize the ecological situation of landscapes around the towns.

3.2. Creation of the green ring of Volgograd (Stalingrad)

The first measures on the safeguarding foresting on the territory of the present Volgograd region are related to the XIX century: stabilization of the Archedinsk-Don sands, creation of the field protective and located near a ravine forest belts on the agricultural lands and the gully banks [21]. In the region of the Ergenskhigh land, the Tingutinsk forest estate, as well as on the interfluve areas of the rivers Medveditsa and Tersa there were laid the forest belts (1887 – 1900 years) [22].

In 1935, in accordance with the plan of creation of the green zone of Volgograd (Stalingrad) there was intended to lay 5 state forest belts, to create 380,9 thousands hectares of the protective forest plantations, to conduct the forest invasion and the sand stabilization on the area of 32,7 thousands hectares. During the Stalingrad battle, many plantings were destroyed or damaged. The works on the restoration of the green ring changed the landscape of the suburban areas of Volgograd, the dust storms ended, and the processes of gullying decreased.

The peculiarity of the structure of the green ring was in the alternation of the forestry crops sections with the orchards. The planting was carried out in the rows, the poplars, the birch were planted in the first rows, then - the forest pear, the silver-chain, the ulmus pumila and the golden currant.

4. Model of the ‘Green ring’ on the example of Volgograd

4.1. Principles of the model building

The principles of building a green ring model on the example of Volgograd became: the consideration of the potential of the local landscape; the formation of the territory with the allocation of different types of spaces (open, half-open and closed); the inclusion in the plantings of a complex of the woody species of the various categories for a variety of the landscape compositions and performing of the recreational, sanitary and hygienic as well as the environmental-forming functions, figure 1.

4.2. Experimental design

The basis of the experimental design was the principles of creating a model of the green ring (figure 1), there were developed the constructions of plantings with a high aesthetic attractiveness (up to 45 points out of 50 possible), recommended for the external green ring formation, figure 2.

The modeling of strands of the cartographic documents of the planning structure of Volgograd was carried out, in which the first strand is the scheme of the planning sector (without ‘the green ring’), the second is the scheme of borders of the urban development; the third strand shows the presence of the green spots in the offered green ring. The obtaining of the planning data of the last strand acquires the meaning of the task order for the projection of the stage of the settlement gardening development of the town, figure 3.
5. Conclusions
The offered methodology of the green ring forming will allow to estimate the considerable potential of the landscape measures in a new way, the results of their implementation in the green structures of the town in the domestic and in the foreign design in the similar environmental conditions.

There was developed the model of the Green ring of the town with the aim to reduce the negative influence of the natural and climatic factor and for the improvement of the comfortable environmental conditions. The ecological analysis of the historical construction of the green ring of Volgograd was carried out for the first time, from the standpoint of making a hypothesis of expanding the possibilities of using the landscape solutions for the settlement gardening of the town. The space organization of the territory should include a variety of types of spaces and the species composition of the plantations, which will undoubtedly increase the recreational attractiveness of the area.

References
[1] Raduova J 2015 J. Vestniksgasu 1(18) 42–46
[2] Lekareva N A, Zaslavskay A J 2014 *Spatial resources of the city. Urban planning strategies* (Saarbrucken, Germany: Lambert Academic Publishing) p 100
[3] Kulik K N, Semenutina A V, Belizkay M N and Podkovyrov I U 2013 *J. Proceedings of the lower Volgaagrodiversity complex* **3(31)** 24–29
[4] Dancheva A V, Zalesov S V 2015 *J. Ural state forest engineering University* p 152
[5] Ivanova N V, Ganzha O A 2017 *J. Vestniksgasu* **50(69)** 221–34
[6] Semenutina A V, Podkovyrov I U 2010 *J. VestnikOrelgau* **5** 39–42
[7] Semenutina A V 2013 *The dendroflora agroforestry complexes* (Volgograd: VNIALMI) p 266
[8] Mattis G Y, Podkovyrov I U 2005 *J. VestnikRussian Academy of agricultural Sciences* 139–41
[9] Ivanova N V, Ganzha O A 2018 *J. Vestniksgasu* **53(72)** 167–75
[10] Ivanova N V, Ganzha O A 2017 Methodical approaches in town-planning design of street circuits in the conditions of sustainable development of the city *J. EMMFT 2017 IOP ConfSeries: Earth and Environmental Science* **90** 6
[11] Ivanova N V, Ganzha O A 2017 The methodological aspect of the landscape and ecological forming of a comfortable environment for the Smart City *J. MATEC Web of Conf: International Science ConfSPb WOSCE-2016 "SMART City"* **106**
[12] Rysin L P, Rysin S L 2012 Urban studies M Association of scientific publications KMK 240
[13] Teodoronskiy V S, Sabo E D and Frolov V A 2008 *Construction and operation of landscape architecture* (Moscow: Publishing center Academy) p 352
[14] Semenutina A V, Podkovyrov I Y, Podkovyrova G V and Semenutina V A 2018 *J. Successes of modern natural science* pp 557–63
[15] Lekareva N A 2011 *Vestniksgasu* **1** 6–9
[16] Kruglyk V V, Semenutina A V and Gureva E I 2017 *J. Vestnik Voronezh state University* **3** 108–12
[17] Latkina T V, Latkin V N 2018 *J. Successes of modern natural science* **9** 93–100
[18] Ivanova N V, Antonova N N 2017 *J. Vestniksgasu* **50(69)** 210–20
[19] Mashtakov D A, Avtoomov A N and Proezdov P N 2018 *J. Successes of modern natural science* **6** 37–42
[20] Forest regulations of the Volgograd city forestry (city forests) Department of environmental protection and natural resources of the Volgograd Administration 2011 (Saratov: Municipal institution "Caracoles") p 92
[21] Mironov V V 1968 *J. Forest industry* 92
[22] Yurchenko V V 2007 *Analytical note: the State of green spaces in Volgograd* vol 102