The main stages of landscape-environmental reconstruction of the "Green Ring" of Russian cities

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Abstract. Conscious use of multifunctional green spaces is the most important direction in the greening of the city. As a constructive full-fledged urban development element, urban and suburban protective green spaces can be considered, which participate in the organization of the city territory, in the formation of the urban landscape, and also have an environmental protection function, determining the ecological well-being of the urban environment [1]. Protective plantations are strips consisting of several rows of plants. In addition to direct protective functions, namely: protecting the soil and microclimate, camouflage and barriers (fences), plantings contribute to the dismemberment and strengthening of the landscape structure, its biological enrichment. They not only provide the natural existence of living organisms of various species (microorganisms, insects, small mammals, birds, etc.), but also contribute to the biological regeneration of adjacent land areas.

1. Introduction

The urban environment is mostly influence by large suburban plantings, forestry and agricultural purposes, as well as suburban protective plantings for special purposes, mainly with wind protection functions. An important role in improving the urban environment is played by plantings of sanitary-protection zones of industrial enterprises and large urban forested areas or city forests, especially those that have a direct connection or access to suburban green spaces.

The interconnection of suburban protective green spaces and city forests is effective if they are rationally located in suburban and urban areas, taking into account the existing environmental load and the climatic features of the region [2].

This is exactly what the planners and agroforestry saw the point when developing projects of forest protection green spaces of cities in different periods of the existence of our country. Initially, wide forest strips were planted in Samara, Stavropol, and then in the Saratov, Orenburg and Voronezh provinces. Over the period from 1886 to 1906, more than 7,000 hectares of Russian territory were afforestation [3, 4]. Over the entire history of protective afforestation in Russia, 5.2 million hectares of protective forest plantings have been planted. By now their area is about 2.74 million hectares [5]. The implemented projects systems of protective green spaces of cities received the generalized name «Green Ring» of the City. Many of them are still preserved, but require reconstruction measures.

2. Main part
In Volgograd, the protective green belt consists of plantations of city forests, forest fund, and natural massifs located in the Gornaya Polyana, Veselaya Balka, Vishnevaya Balka, as well as in the suburban area of the city [6, 7].

The formation of the outer green belt of Volgograd was begun in 1935 [8], these works were suspended only during the Great Patriotic War.

At the first stage, the main goal of afforestation was to fix sand, ravines, and weaken water and wind erosion. First of all, plantations were created on the sands, along the borders of the lands of the «Green Ring», along steep slopes, on the tops of ravines. At the same time, fruit gardens and vineyards were created on the lands.

Forest cultures of the «Green Ring» were arranged in the form of strips of various widths and designs. Small solid arrays were also created.

Gullies were bordered by forest strips with a width of 10 to 40 m. On small areas of shallow watersheds, ravines, near the boundaries of urban development, forests were created, ranging in size from 2 to 10 hectares. Larger sizes created continuous plantations of conifers, mainly ordinary pine. The cultures of this breed occupied different areas in the massifs, for example, on one there were 40 hectares, and on the other 20 hectares.

In Soviet times, fruit trees were grown in large numbers, the bulk of which were apple trees. A feature of the «Green Ring» of Volgograd was the alternation of forest areas with orchards. The combination of forest and garden planting has become a new technique for creating green areas around cities in the southeast.

In the summer of 1953, work began on the creation and cultivation of state forest belts. For this period, in the Green Ring plantings there were gardens of 843 ha, forest parks of 230 ha, forest crops of 1390 ha, nurseries of 40 ha.

But already on 1 January 1966 the Volgograd «Green Ring» included: natural bayrach and floodplain forests - 500 hectares; artificial plantations - 3719 hectares; state forest strips - 1789 hectares, steppe oak forest plots - 454 hectares [9].

Thus, for the period 1950-1966, the «Green Ring» of Stalingrad-Volgograd was formed, which included:
1. Forest protective strip Volgograd-Kamyshin with a length of 42 km;
2. Forest protective strip Volgograd-Cherkessk with a length of 23.5 km;
3. Forestry (Traktorozavodskoye, Dzerzhinskoye, Gorodishchenskoye, Voroshilovskoye, Kirovskoye, Krasnoarmeyskoye).

The «Green Ring» of Volgograd became an example of solving the problem of improving the quality of the urban environment. Thanks to the created protective green spaces, the townspeople forgot what “Volgograd rain” is - a southeast wind saturated with sand and dust [10, 11].

Despite the obvious need for a protective green space for the city, area and extent of the Green Ring of Volgograd since 2006 is rapidly declining. Studies conducted by the authors in 2018-2019, to reveal reduction of halving of the area occupied by city forests in Volgograd. An inventory of the territories of city forests of Volgograd showed:
- Most of the forests of the Dzerzhinsky forestry is given for residential development - 350 hectares;
- 80% of the plantations of the Krasnoarmeysky forestry have dried up - 2 thousand hectares;
- 50% of the city forests of the Kirovsky forestry are in unsatisfactory condition – 1.4 thousand hectares;
- 40% of the city forests of the Voroshilovsky forestry destroyed – 1.5 thousand hectares;
- total 30% of the plantations remained in the Traktorozavodsky forestry - 1 thousand hectares.

The preserved sections of the forest protection strip Kamyshin-Volgograd remained mainly outside the city. The total length of these sections is 28.5 km, consists of three lanes of 60 m each with a distance between the lanes of 300 m. A fragment of the protective forest strip Volgograd-Cherkessk was preserved in the Sovetsky and Krasnoarmeysky areas. It consists of four strips of 60 m each with
a distance between the strips of 300 m. The total length is 7.52 km. Plots of the forest protective strip Volgograd-Cherkessk almost did not survive, due to the transfer of land for residential construction.

Studies of the state of the species and quality composition of the green spaces of the Green Ring” confirmed their inconsistency with urban planning and sanitary and hygienic requirements. Under the influence of industrial and transport pollution, climatic features, unorganized recreation of citizens degradation of green areas occurs, the area of territories occupied by protective plantings is given for development, a cemetery or is used as a natural dump.

In connection with the significant loss of areas of forest protection plantings of Volgograd and the decrease in their effectiveness, the urgent task is to develop measures for the recovery and functioning of the «Green Ring» of Volgograd, that is, its landscape-environmental reconstruction.

Reconstruction of protective forest planting (strips) - set of forestry, forestry and agricultural activities, measures aimed at a radical change in the species composition, mixing and placement of forest species, planting structures to increase wind permeability of strips, and in some cases, to improve the overall condition of the planting.

The reconstruction of the «Green Ring» Volgograd, according to the authors, should be as follows:
1. in the recovery of green spaces of protective strips in the preserved sections of the «Green Ring»;
2. in the design of sections of protective bands of the «Green Ring» in new territories;
3. in the recovery of green spaces, in areas occupied by city forests (forestry);
4. in designing new city forests in new territories.

Stage 1. Recovery of green spaces of protective strips in the preserved sections of the "Green Ring".

The preserved green protective stripes of the «Green Ring» remained largely outside the city. The total length of these sections is 28.5 km, width is 700 m, the condition is satisfactory. The only preserved section of the protective strip in the city is located in the Soviet district. The length of this section is 3.42 km, the state is extremely unsatisfactory. It is necessary to carry out work to restore green spaces of a fragment of the protective strip of the «Green Ring» in the Soviet district. To do this, it is proposed:
1. analysis of the state of green spaces;
2. sanitary pruning of surviving plants;
3. planting new green spaces with selection of assortment according to the climatic characteristics of Volgograd;
4. organization of care for new landings and monitoring;
5. ensuring the process of self-financing. This refers to the self-provision of protective plantings by organizing nurseries on the territory of urban forests for their reproduction.

Stage 2. Design of sections of protective bands of the «Green Ring» in new territories.

The selection of new territories for the placement of protective green stripes should be guided by the following criteria:
- localization, which reflects the remoteness of the site from the city limits. The estimated restriction of the protective green band within the radius for cities with a population of:
  - more than 1 million people - the radius of the protective green strip is 60-80 km;
  - from 500 thousand to 1 million - the radius of the protective green strip is 30-40 km;
  - from 250 to 500 thousand - the radius of the protective green strip is up to 20 km.
- The influence of green spaces on local conditions is limited to 50-200 m, therefore large tracts should be supplemented by smaller ones.

Protective strips should be placed along bypass roads at a distance of 30 m, on both sides of the road, or on one side, but taking into account the prevailing winds of the area, in order to ensure dust removal [8.9] of air and snow retention.

In order to make up for the lost fragments of the Green Ring of Volgograd, it is proposed to develop projects for the placement of protective bands in territories previously occupied by protective bands, as well as in new territories. Measures to restore the lost protective plantings of the Volgograd-
Kamyshin strip on the territory of the Gorodishchensky district of the Volgograd region will help restore and return to the city 3.2 km of the lost protective strip. In order to place protective strips on fundamentally new territories, it will require a new allotment of land on the territory of the Gorodishchensky district, 25.4 km long, and also on the southern border of Volgograd on the territory of Svetloyarsky district, 21.9 km long.

In addition, the authors propose the placement of a new protective forest strip – «Green Ring-2». In 2019, a large-scale project was launched to design the M-4 bypass highway around the city of Volgograd. According to the master plan, the road will go beyond the existing green ring, which will not be able to protect the road from snow drifts.

The remoteness of the «Green Ring – 2» from the M-4 bypass is provided by the authors, at a distance of 30 m. The length of the strip is 72 km.

To provide protective forest plantations, a nursery will be created on the territory of the Voroshilov forestry, with an area of 80 hectares.

Stage 3. Recovery of green spaces, in areas occupied by city forests (forestry).

The city forests of the city of Volgograd are currently represented by five forest districts, which are in unsatisfactory condition and need recovery measures. Reconstruction of plantings at landscaping facilities can be full or partial, and in some cases - both full and partial. With a complete reconstruction, all plantations are replaced in connection with their degradation and withering away. In addition, there is a need for redevelopment of sites and the entire territory. Tree stands are removed by 80-100%. In partial (selective) reconstruction, part of the plants is replaced, diseased, dying plants are removed or replaced. Woody plants are removed by 15-20%.

Stage 4. Designing new urban forests in new territories.

Due to the fact that the area of city forests is rapidly decreasing, it is necessary to fill the shortage of green spaces inside the city due to the annual planting of at least 60 hectares of new plantings. To identify areas suitable for new urban forests, the authors propose the following main activities:

1. Assessment of actual city boundaries and their prospective expansion in accordance with the approved Master Plan of the city of Volgograd;
2. The choice of placement of design protective strips, taking into account the existing and future boundaries of the city;
3. Determination of the conformity of the territorial zones of design sites with the placement of forest-protective green spaces;
4. If a discrepancy is identified with the permitted type of use, work is done to change the status of territorial zones.

3. Conclusions

The creation of forest park urban green belts of Russian cities is determined by Chapter IX.1 of the Federal Law “On Environmental Protection Conducted by the Environment” for the purpose of limiting the use of natural resources and preserving natural ecological systems. Forest park green belts are a new form of realization of the right of urban residents to a favorable environment. In the zones of forest-steppes and steppes, important bioclimatic and environmental requirements are imposed on the functioning of forest-park green belts: in winter - protection from winds, in summer - protection from dust storms, dry winds, insolation, fixing slopes, ravines, soils [10-12]. Forest park green belts must bear significant ecosystem load. The system of protective plantations forms the basis of a sustainable landscape and is an indispensable element in the system of its self-regulation, preservation and improvement of the environment.

Work on landscape-ecological reconstruction of protective green belts of Russian cities should consist of:

1. In the recovered of green spaces in the preserved sections of the protective strips of green belts;
2. In the design of forest protection areas (strips) in new territories;
3. In the recovered of green spaces in the territories occupied by city forests (forestry);
4. In the design of new city forests in new territories.

The placement of forest park protective belts in the city’s landscaping system can be uniform, uneven, annular, wedges.

A uniform ring arrangement of green zone forests is most appropriate for cities with well-developed transport routes. Forests in the form of separate massifs, groves and stripes should be located near settlements or cities in treeless areas where there is a need for protection from dry winds, dust storms, snow drifts, transport and industrial emissions.

Arrays of plantings alone are not able to provide a sufficient healing effect on the entire urban development. For greater results, they should be more closely related to buildings, linear pedestrian links (green stripes), complemented by gardens and small parks located among residential buildings.

All landscaped areas should be formed in the form of a single developed and continuous territorial system that can provide the best wind protection and aeration.

Ideally, the configuration of future forest park protective belts of cities should be a kind of wheel with spokes, where the rim is suburban forests (with the subsequent filling of its gaps along the perimeter of the city line), and the spokes are city parks that protrude wedges into the city building.

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