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EXPERIENCE IN CREATING ARTIFICIAL FOREST PLANTS IN THE TERRITORY OF BELGOROD REGION

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Abstract. The experience of creating artificial forest plantations on the territory of the Belgorod region within the framework of the "Green Capital" project is considered. As part of the project, it was envisaged to create more than 100 thousand hectares of forest plantations on chalk slopes and erosion-hazardous areas of the region for 2010 - 2020, that is, bringing the forest cover of the region to 15% - the optimal value for the region. For the period 2010 - 2020 forest plantations were laid on the territory of more than 87.7 thousand hectares. For afforestation in the region, species are recommended that provide sustainable, durable and ecologically capacious afforestation: as the main species on chernozem soils: *Quercus robur* L., *Q. rubra*, *Fraxinus excelsior* L., *Larix sibirica* Ledeb.; on sandy soils - *Pinus sylvestris* L. Reforestation has been carried out since 2010 on the territory of 22 districts of the region. In 2016-2020 more than 6 thousand hectares of oak forests were created. As a result, the species *Q. robur* occupies an area of 22.2% of the area of artificial plantations; *P. sylvestris* accounts for 13.2% of the area of artificial plantations in the oblast. Next in terms of planting volumes are such crops as *A. hippocastanum*, *R. pseudoacacia* and *F. excelsior* - 12.1%, 24.7% and 14.4%, respectively. The share of fruit crops, as well as *B. pendula*, *A. platanoide*, *A. campestre*, and *U. laevis*, is 11.7%.

Keywords: reforestation, survival of forest crops, the Green Capital project, seedlings, seeds.

1. Introduction

From 2010 to 2020, a large-scale project "Green Capital" was being implemented on the territory of the Belgorod Region. Its concept is a unique example of artificial reforestation in the region of the Russian Federation. This project was created in order to improve the aesthetic level of improvement and landscape design of settlements in the region, to form a comfortable living and recreation environment for residents of the region, to achieve ecological balance and improve the environment [1-5].

The project was based on the works of domestic and foreign researchers [6-9].

The importance and necessity of systematic work and research on afforestation is widely discussed in the scientific literature. The features of reforestation in the long-term agricultural use of geosystems,



the selection of species for reforestation, the state of carbon balance, water exchange and other issues are studied [10-16].

Before the implementation of the Green Capital project (2010), the forest cover in the region was 9.8%, while the historical forest cover was 25% (in the 17th-18th centuries). As part of the project, it was envisaged to create more than 100 thousand hectares of forest plantations on chalk slopes and erosion-hazardous areas of the region for 2010 - 2020, that is, bringing the forest cover of the region to 15% - the optimal value for the region.

The purpose of the research was to assess the state of protective forest plantations in the Belgorod region and the results of a project to create artificial forest plantations to increase the bioresource potential of the region.

2. Methods and materials

The Belgorod region occupies the southern and southeastern slopes of the Central Russian Upland and is located in the center of the European territory of Russia, it is an elevated erosion-denudation plain with an average height of about 200 m, dissected by a valley and ravine-gully network. The total length of the gully-ravine network on the territory of the Belgorod region is about 50 thousand km (comparable to the length of the Earth's equator) [17].

The territory of the region is an elevated plain, along which the southwestern spurs of the Oryol-Kursk plateau of the Central Russian Upland run, dissected by numerous river valleys and a dense gully-ravine network. The northern part of the region is located in the forest-steppe zone, the southeastern part - in the steppe zone.

A natural feature of the vegetation cover of the Belgorod region is the insular distribution of broad-leaved forests, oak forests, as well as areas of steppe vegetation. In the floodplain and gentle left-bank sections of the river valleys, there are meadows and artificial plantations of pines.

The climate is temperate continental, with mild winters with snowfalls and thaws and long summers. The growing season lasts from 187-197 days, depending on the area. The greatest amount of precipitation is typical for the western and northern regions of the region (540–550 mm). As we move from west to east and southeast, the amount of precipitation decreases (up to 400 mm).

Sowing of forest plots in the Belgorod region within the framework of the Green Capital project was carried out annually, starting in 2010, in the autumn-spring period. Reforestation was carried out on the territory of 22 districts of the region. Furrows for planting plant material were cut with a tractor, then the plants were planted manually using Kolesov's sword - a device for manual planting of seedlings and seedlings of forest crops.

3. Results and discussion

The forests of the Belgorod region, located on the lands of the forest fund, and forests located on the lands of other categories, according to the Forest Code of the Russian Federation, are classified as protective for their intended purpose. There are no operational and reserve forests on the territory of the Belgorod Region. The distribution of the forest area of the Belgorod region by types of designated forest use is shown in Table 1

Table 1. Distribution of the forest area on the lands of the forest fund of the Belgorod region by types of designated forests

Protective forest category	Area, ha
Forest park zones	40 506
Anti-erosion forests	182 959
Forests of scientific or historical significance	1 270
Forests located in water protection zones	2 451
Protective forest belts located along public railways, federal public highways, public highways owned by the constituent entities of the Russian Federation	2 629
Total:	229 815

On the territory of the region there have been preserved forest belts along the perimeter of highways and farmland, planted more than 60 years ago. According to our estimates, currently 86.5 thousand hectares of protective forest plantations grow on the territory of the Belgorod Region. Protective forest belts account for 30.4% of all types of protective plantations, anti-erosion functions are performed by 49.7%, other plantations account for 19.9%.

The analysis of the age stages and the species composition of the stands made it possible to establish that they are divided into 4 groups.

I group. Plantings are between the ages of 5 and 20, accounting for 15%. They consist of fast-growing species of poplar (*Populus L.*), drooping birch (*Betula pendula* Roth.), White acacia (*Robinia pseudoacacia L.*).

II group. Plantings at the age of 21–45 years, area - about 45%. They consist of plantations of pedunculate oak (*Quercus robur L.*), common ash (*Fraxinus excelsior L.*), silver birch (*B. pendula*), common pine (*P. silvestris*) and common elm (*Ulmus laevis* Pall.).

III group. Planting at the age of 46–60 years, the area - about 38%. The tree species in them are mainly represented by *Q. robur*, *F. excelsior*, *U. laevis*, *Acer negundo L.*, with a significant participation of shrubs - *Caragana arborescens* Lam., *Lonicera xylosteum L.*, *Sambucus racemosa L.*, etc.

IV group. Plantations over 80 years old, which were created in the pre-war period, occupy 2% of the area. Represented by plantations of *Populus alba L.*

On the territory of the region, middle-aged stands of hard-leaved species *Q. robur* and its satellites - *F. excelsior*, *U. laevis*, *Acer platanoides L.*

Q. robur belongs to the species that are sufficiently salt-tolerant, drought-resistant and windless, therefore, it can be used for afforestation in the steppe and forest-steppe zones. Forms clean and mixed stands. The area of plantings *Q. robur*, which, depending on the bonitet class, is called either high-stemmed or low-stemmed, is 161.5 thousand hectares (74% of the total area covered with forest vegetation). High-stemmed oak of seed origin forms plantations of III and higher quality classes, low-stemmed oak of seed origin IV and lower. High-stemmed oak of coppice origin forms stands of II and higher quality classes, low-stock oak of coppice origin - III and below.

Oak satellites: *F. excelsior*, *U. laevis*, *A. platanoides*, *Tilia cordata* Mill. *F. excelsior* is the most widespread of these.

The plantations of *F. excelsior* account for 5.7% of the area covered with forest vegetation, forming a stand of I – II quality classes.

Ulmus laevis and *U. glabra*, under our conditions, forms medium-productive plantations of the II quality class.

Plantations of *T. cordata* are 1.0 thousand hectares (0.4% of the area covered with forest vegetation). *T. cordata* forms medium-productive plantations, predominantly of the II quality class.

Of conifers, *P. silvestris*, *Picea abies*, *Larix sibirica* grow in the forests of the Belgorod Region; Weymouth pine and Crimean pine are also found.

P. silvestris forms highly productive forest stands of Ia - I quality classes, clean in composition, represented mainly by forest cultures. The area of pine forests is 19.8 thousand hectares (9.1% of the area covered with forest vegetation).

Populus tremula L., *Alnus glutinosa L.*, and *B. pendula* are the most widespread in the Belgorod region of soft-leaved species.

P. tremula occupies 2.7% (6.0 thousand hectares) of the area covered with forest vegetation, forming a tree stand of the I quality class. A negative feature of aspen is manifested in its strong infestation with parasitic fungi, as well as susceptibility to heart rot.

A. glutinosa is represented by clean stands, predominantly of quality class II, accounting for 2.1% (4.5 thousand hectares) of the land covered with forest vegetation.

B. pendula is one of the most widespread forest-forming species in Russia. The area of birch forests is 1.1% (2.4 thousand hectares) of the area covered with forest vegetation. In the conditions of the Belgorod region, birch forms plantations of Ia - I quality classes.

In the Belgorod region, shrub thickets usually form an undergrowth of deciduous forests. The following types of shrubs and shrubs prevail: *Corylus avellana*; *Lonicera xylosteum*; *Frangula ainus*; *Euonymus verrucosa*; *Sambucus racemosa*; *Viburnum opulu*; *Daphne mezereum*; *Acer tataricum*; *Caragana arborescens*; *Ribes aureum*.

Taking into account the results of the research, it was recommended for use by the forestry enterprises and forestries of the region, instead of the traditional fast-growing tree species, species that ensure the receipt of sustainable, durable and ecologically capacious forest plantations. It is advisable to plant *Q. robur* and *Q. robra*, *F. excelsior*, *L. sibirica* as the main species, and *P. sylvestris* on sandy soils. The accompanying breeds are *A. platanoides*, *A. tataricum*, *T. cordata*, *Pyrus communis* subsp. *pyraster*, *Acer campestre*, *Sorbus aucuparia*, *B. pendula populus* (preferably with a pyramidal crown). From shrubs to forest plantations, *C. arborescens*, *Ribes aureum*, *L. tatarica*, etc. should be introduced.

These recommendations were taken into account when implementing the Green Capital project. Within the framework of the "Green Capital" project in 2010–2020. on the territory of the Belgorod region, a large amount of work was carried out to create and inventory artificial forest plantations.

Data on the distribution of areas of artificial forest plantations created within the framework of the "Green Capital" project on the territory of the Belgorod region, for certain types of crops, are shown in Table 2.

Table 2. Distribution of areas of artificial forest plantations created within the framework of the "Green Capital" project in various zones of the Belgorod region, by types of crops, hectares

sequential number	District	<i>P. sylvestris</i>	<i>Q. robur</i>	<i>A. hippocastanum</i>	<i>R. pseudoacacia</i>	<i>F. excelsior</i>	Other cultures
Western zone of the Belgorod region							
1.	Borisovsky	277	889	36	326	10	182
2.	Graivoronsky urban district	212	120	446	769	3	297
3.	Ivnyansky	54	1112	55	950	56	112
4.	Krasnoyarsky	447	666	12	450	118	206
5.	Rakityansky	154	540	303	1199	460	167
6.	Yakovlevsky urban district	533	797	221	795	114	193
Central zone of the Belgorod region							
7.	Belgorodsky	319	877	459	1323	0	381
8.	Prokhorovsky	348	825	1214	1507	0	758
9.	Korochansky	215	1634	0	718	438	1434
10.	Novooskolsk urban district	640	1527	681	971	823	424
11.	Chernyansky	123	1583	165	85	1537	541
12.	Gubkinsky urban district	895	1112	1514	747	327	75
13.	Starooskolsky urban district	1951	424	404	69	346	327
14.	Shebekinsky urban district	148	244	74	1625	186	1537
15.	Belgorod	63	2	0	144	9	12

Southeast zone of the Belgorod region							
16.	Alekseevsky urban district	589	893	628	3743	663	862
17.	Valuysky urban district	892	300	878	764,9	1854	684
18.	Veidelevsky	1249	1595	103	1351	1888	238
19.	Volokonovsky	709	577	870	728	1121	167
20.	Krasnensky	364	1216	351	277	602	645
21.	Krasnogvardeisky	565	1131	1535	1281	1397	849
22.	Rovensky	874	1404	642	1858	393	224
Total 2010–2018		11627	19470	10596	21685	12345	3759

For the implementation of the afforestation program, the following main tree species were selected: *Q. robur*, *P. silvestris*, *Aesculus hippocastanum* L. and *Robinia pseudoacacia* L., *B.pendula*, *A. platanoides*, *Pyrus communis* subsp. *pyraster*, *A. campestre*, *S. aucuparia*, *Prunus cerasifera* Ehrh., *Armeniaca vulgaris* Lam., *Prunus cerasus* L., *F. excelsior*, *Malus sylvestris* (L.) Mill.), *U. laevis*.

As a result of the inventory carried out in 2018, it was found that the species *Q. robur* occupies in the region 22.2% of the area of artificial plantations. The maximum area of oak planting in Chernyansky, Novooskolsky and Veidelevsky districts is more than 1500 hectares in each.

The share of *P. silvestris* planted in the region accounts for 13.2% of the area of artificial plantations, of which the maximum area in the Veidelevsky district and the Starooskolsky urban district is more than 1200 hectares.

Next in terms of planting volumes are crops such as *A. hippocastanum*, *R. pseudoacacia* and *F. excelsior*. They account for 12.1%, 24.7% and 14.4%, respectively, which in aggregate amounts to 51.2% of the total area of artificial plantations.

The share of fruit crops, as well as *B. pendula*, *A. platanoides*, *A. campestre*, and *U. laevis* is 11.7% (most of them are represented by fruit crops - 9.3%) of the total area of artificial plantations. The maximum area of fruit crops was planted in the Korochansky district, Alekseevsky and Shebekinsky urban districts - more than 700 hectares in each.

4. Conclusion

1. Reforestation has been carried out since 2010 on the territory of 22 districts of the region. The planned indicator of laying artificial forest plantations in the region was 86285.6 hectares. It was fulfilled by 101.5%.

2. For afforestation in the region, species are recommended that provide sustainable, durable and ecologically capacious afforestation: as the main species on chernozem soils - *Q. robur*, *Q. ribra*, *F. excelsior*, *L. sibirica*; on sandy soils – *P. silvestris*.

2. Forest plantations were predominantly established by seedlings and seedlings on an area of 63.1%. Sowing seeds was used on an area of 36.9%. As a result of the project implementation, the species *Q. robur* occupies 22.2% of the area of artificial plantations; *P. silvestris* accounts for 13.2% of the area of artificial plantations in the oblast. Next in terms of planting volumes are such crops as *A. hippocastanum*, *R. pseudoacacia* and *F. excelsior* - 12.1%, 24.7% and 14.4%, respectively. The share of fruit crops, as well as *B. pendula*, *A. platanoides*, *A. campestre*, and *U. laevis*, is 11.7%.

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