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FOREST RESTORATION AND FORESTRY ON TERRITORIES CONTAMINATED WITH CESIUM-137

Since the accident at the Chernobyl nuclear power plant, there have been noticeable changes in the current radiation situation. In many respects, this was facilitated by the implementation of a set of protective measures, the main of which is the forests reproduction in contaminated areas.

The natural environment radioactive contamination on the territory of Belarus began immediately after the explosion of the reactor. An analysis of radioactive contamination by Cesium-137 on the European continent shows that about 35% of Chernobyl fallout is located on the territory of Belarus. Contamination of Belarus with Cesium-137 with a density of over 37 kBq/m² amounted to 23% of the total area of the republic, including 20.1 thousand of square kilometers of the forest fund (for Ukraine – 5%, Russia – 0.6%). Given the scale and severity of the consequences of the disaster, the territory of the republic was declared a zone of ecological disaster.

The maximum level of soil contamination with Cesium-137 was recorded in the Gomel and Mogilev regions. In parts of the Brest, Grodno and Minsk regions, radioactive contamination reached up to 15 Ci/km² [1].

Over the years since the accident, there have been significant changes in the radiation situation: the radioactive decay of short-lived isotopes and the migration deep into the soil of long-lived isotopes, the partial radioactive decay of Cesium-137 (half-life of 30 years) led to a significant decrease in the level of gamma radiation.

The main part of the contaminated forests is under the jurisdiction of the Ministry of Forestry of the Republic of Belarus (83 %) and the Department for the Elimination of the Consequences of the Catastrophe at the Chernobyl Nuclear Power Plant of the Ministry of Emergency Situations of the Republic of Belarus (13.8 %). As of January 1, 2022, the area of radioactive contamination of the forest fund of the Ministry of Forestry of the Republic of Belarus amounted to 1194,43 thousand hectares [2].

Zone 1-1 to 5 Ci/km² (residence zone with periodic radiation monitoring) – the area of radioactive contamination is 849.23 thousand hectares (71,10 %).

Zone 2 – 5 to 15 Ci/km² (zone with the right of resettlement) – the area of radioactive contamination is 284.22 thousand hectares (23.79 %).

Zone 3 – 15 to 40 Ci/km² (zone of subsequent resettlement) – the area of radioactive contamination is 60.74 thousand hectares (5.09 %).

Zone 4 – above 40 Ci/km² (zone of priority resettlement) - the area of radioactive contamination is 0.24 thousand hectares (0.02 %).

The radiation situation in the contaminated forests is stabilizing. Over time, the areas of each zone of radioactive contamination decrease, and there is a transition from a zone with a higher contamination density to a zone with a lower contamination density (table 1).

Table 1

Distribution of the forest fund of the Ministry of Forestry of the Republic of Belarus according to the severity of radioactive contamination [2]

Region	Territory, thousands of hectares	Area of contamination, thousands of hectares					
		total, thousands of hectares	by zones				
			1–2 Ci/km ²	2–5 Ci/km ²	5–15 Ci/km ²	15–40 Ci/km ²	40+ Ci/km ²
Brest	438,8	72,32	49,05	21,21	2,06	-	-
Gomel	16,61,2	741,95	266,08	236,07	196,47	43,09	0,24
Grodno	274,3	12,77	11,97	0,8	-	-	-
Minsk	521,3	26,45	20,15	6,19	0,11	-	-
Mogilev	928,5	340,94	121,99	115,72	85,58	17,65	-
Total	3824,1	1194,43	469,24	379,99	284,22	60,74	0,24

To ensure sustainable forest management in areas of radioactive contamination, a set of protective measures is being implemented, the main of which are reforestation and afforestation, protection of forests from fires, and ensuring radiation safety of workers. Reforestation and afforestation in zones of radioactive contamination are carried out in accordance with the Decree of the Ministry of Forestry of the Republic

of Belarus «Regulations on the procedure for reforestation and afforestation» and «Rules for forestry in areas exposed to radioactive contamination» [3, 4].

Reforestation of the forest fund, afforestation, and creation of forest plantations is carried out in all zones of radioactive contamination.

In zones 1–3, it is allowed to create permanent forest seed bases (such as forest seed plantations and plots) and harvesting seeds of forest plants. In zone 4, permanent forest seed bases are used for scientific and experimental purposes.

Permanent and temporary forest nurseries are established in zones 1 and 2. Planting material of forest plants (seedlings, saplings, cuttings, planting material with a closed root system) is used to create forest plantations in forests in all zones of radioactive contamination.

In zone 4, all non-forested lands are left for natural reforestation. The promotion of natural reforestation is carried out in zones 1–3.

Table 2 provides data on the reproduction of forest plantations on lands territories with radionuclides for 2021.

Table 2

Forest restoration and forestry on territories contaminated with Cesium-137

Region	Reforestation – total hectares	Including with the level of soil contamination		
		1–5 Ci/km ²	5–15 Ci/km ²	15–40 Ci/km ²
Republic of Belarus	7937	5899	1349	689
Ministry of Forestry, including	7487	5790	1349	348
Brest region				
Gomel region	441	439	2	-
Grodno region	5566	4310	1074	182
Minsk region	53	53	-	-
Mogilev region	58	58	-	-
	1369	930	273	166
Excluded from agricultural use				
Republic of Belarus	318	40	4	274
Ministry of Forestry, including	20	16	4	-
Gomel region	16	16	-	-
Mogilev region	4	-	4	-

Afforestation can significantly improve the ecology of the contaminated territories, especially on lands of former agricultural use, as it transfers a significant part of the polluted waters surface runoff into subsoil, reduces wind speed and reduces the transfer of radionuclides along with the dusty part of the soil uncovered by vegetation.

Soil radioactive contamination is not an obstacle to the growth and development of trees. Restrictions in reforestation are due to the need to ensure the radiation safety of workers, which does not always make it possible to meet forestry requirements for optimizing the conditions for the growth of forest plantations.

Radioactive contamination of soils requires a special approach for work processes, therefore, in order to create forest crops, it is necessary to follow special measures to ensure afforestation without harm to health and the environment:

- in the presence of fruit-bearing forest edges or stand alone trees, the seeding capacity of those should be used with the adoption of measures to promote the natural renewal of trees;

- when creating forest plantations, the necessary minimum of production operations is provided, with the goal of reducing labor costs, time spent by workers on forest cultivation areas, and the possibility of re-transfer of soil radionuclides with dust;

- afforestation of radionuclide-contaminated lands should be carried out in early spring or late autumn on moist soil, preferably in calm weather. The movement of workers is carried out along the furrows, where the gamma contamination is the lowest. The furrows are also used to store planting material and tools.

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