MINISTRY OF FORESTRY OF THE REPUBLIC OF BELARUS

STATE SCIENTIFIC INSTITUTION
«THE INSTITUTE OF FOREST OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF BELARUS»

"BELARUSIAN FORESTRY DEVELOPMENT PROJECT"
GEF/THE WORLD BANK
TF0A1173

Adopted
First Deputy Minister of Forestry

_____ Aleksandr Kulik

7TH STAGE REPORT

under the Contract No. BFDP/GEF/CQS/16/15-04/16
dated May 18, 2016

"The final report including recommendations for updating the firefighting zoning of the Republic of Belarus taking into account the peculiarities of climatic, economic ecological and organizational region factors and radioactive contamination of their territories"

Project Component 2: Improving Forest Fire Prevention, Monitoring, Detection and Suppression
Project Activity 2.1: 'Updating the firefighting zoning of the Republic of Belarus'

Executing Agency

Director of SSI «Institute of Forest of the NAS of Belarus»
_____ A.I. Kovalevich

Gomel, 2017

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TERMS AND DEFINITIONS, ACRONYMS

Inflammability of forests – a ratio of the total area of forest fires (hectare) to a unit of the whole area of forest lands (one thousand hectares).

Class of fire hazard by weather conditions – the relative assessment of the level of fire danger of forests caused by weather, in case of invariable other fire features of the territory and invariable source of fire.

Forest Coverage – the level of forestation of the territory which depends on the relation of the area of the lands covered with the forest to its total area.

Forest Firefighting Zoning – division of the territory of the forest fund into the regions (belts) uniform in respect of the forest fires, taking into account forest vegetation, economical and ecological, organizational and economic factors of the region.

Coefficient of radioactive pollution gravity –the complex index considering pollution of the whole area of a forestry in absolute and relative units, average density of pollution of the territory of a forestry and indices of pollution of separate structural subdivisions.

Frequency of fires – the number of forest fires per fire-dangerous season (year) or an average long-term indicator for the amount of forest fires per one thousand hectares of the protected of the forest fund of a forestry, a region or the whole country.

Firefighting arrangement of the forest fund – the system of actions, which prevent and restrict the origin and spread of fires, promote their detection and elimination.

BFFE - Backpack Forest Fire Extinguisher

BSR - Basic Sanitary Rules

CHUE – Communal Unitary Housing Enterprise

EE BSTU – Education Enterprise Belarusian State Technological University

EFB – Experimental Forest Base

FFCS - Fire Fighting and Chemical Stations

FOM - Fire Observation Mast

FOT - Fire Observation Tower

FSR – Fire Safety Rules

GD RB – the Governing Document of the Republic of Belarus

HN – Hygienic Norm

MM – Methods of Measurements

NAS - National Academy of Sciences

NP – National Park

NPP – Nuclear Power Plant

PCUE – Production Communal Unitary Enterprise

RSS - Radiation Safety Standards

RUE – Republican Unitary Enterprise

SAERI - State Aviation Emergency Rescue Institution

SERUE – Scientific and Engineering Republican Unitary Enterprise

SSR - Soviet Socialist Republic

SFPA – State Forestry Production Association.

SMUPE – Soligorsk Municipal Unitary Production Enterprise

SSI – State Scientific Institution

STB – Standard of Belarus

TCEP – Technical Code of Established Practice

TNPA - Technical Normative Law Act
UUPE – United Unitary Production Enterprise

EXECUTIVE SUMMARY

The report consists of 108 pages, 26 tables, 18 figures and 3 annexes.

1. Within 1959-2016 in the forest fund 135831 fires on the total area of 215022 hectares took place. Death of forest plantations, deterioration in the qualitative structure of the forest fund, decrease in nature protection and the environment forming functions of forests are the consequence of the fires, which result in significant material and ecological damage.

2. The average area of one fire, which is an indicator of efficiency of its detection and elimination, made 1,58 hectares at a minimum of 0,16 hectares and a maximum of 13,91 hectares in 2015. The minimum number of wildfires happened in 2013, and the maximum of their emergence, both in quantity of cases (8121), and on the total area (25683 hectares) captured by them was observed in 1992.

3. It was found out that the largest specific weight in the area of the forest fund of the Republic which was undergone by fires belonged to local fires (77,5%), the smallest – to soil ones (1,7%), the individual share of upper fires made 20,8%. The overwhelming number of wildfires (70,7%) during 2006-2015 happened because of the population, 6,8% - because of agricultural burnings, and the share of the unspecified reasons is 22,5%.

4. Over the past ten years, 1533 fires occurred in the area of major cities of the Republic on a total area of 1111,42 hectares, including 166 fires on an area of 215,73 hectares only in CY 2015. The greatest number of fires was recorded in Babruysky and Mogilev forest entities (285 and 275 cases), the smallest - in Vitebsk and Baranovichsky forest entities - 49 and 52 cases respectively. At the same time, the largest area covered by fires was recorded in Gomel forest entity – 205,75 hectares, including 12,04 hectares in 2015. A small average fire area per year for a long observation period (0,72 hectares) indicates the rapid detection and elimination of forest fires, transport availability.

5. For the last five years annual costs of firefighting arrangement of the territory of the forest fund of the Ministry of Forestry of Belarus have averaged 471 thousand US dollars, at the average inflammability of 0,1603. The maximum average inflammability for this period is noted in Gomel SFPA (0, 55786), and the minimum one in Grodno SFPA – 0,01698.

6. In the forest fund of the state forestry production associations starting from CY2011 to CY2015 costs of fire-prevention actions increased by 1,2–1,5 times, at the same time inflammability of forests in separate years remains high. Thus, in the forest fund of Gomel SFPA in 2011 the costs of fire-prevention arrangement made 501,6 thousand USD, and inflammability

of forests – 0,014. In 2015 expenses increased to 821,4 thousand USD, at the same time inflammability of forests also increased and made 2,6879.

7. Based on the books of accounting of wildfires the database of fires in the forest fund of the country for the period from 2001 to 2015 was developed, including information on wildfires within the specific area: forestry, forestry unit, quarter, compartment, fire origin time, reason and fire area (Annex A). The database is made in the form of the electronic spreadsheets connected in the Excel format with comfortable interface and makes information storage, and its use for data analysis and later processing is also possible.

8. The existing system of wildfires detection is based on implementation of visual observations from aircraft and fire and observation towers and masts, remote video surveillance and land patrol by workers of the state forest protection services with a total number of 13458 people (as of 01.01.2016).

9. In the forest fund of the country remote visual monitoring of fires is made on the basis of use of 465 firewatchers and 51 fire and observation towers, remote video monitoring - 341 video cameras with a radius of review up to 20 km.

10. Aviation forest protection is a component of the general complex of actions for forest fire protection. The number of the wildfires arisen, found and extinguished with the help of the aircraft on the protected territory during the CY 2010-2015 makes annually, on average, 41%.

11. The selection of ways and technical means for firefighting is made in accordance with the type and intensity of the fire, presence of forces and fire extinguishing means planned by policy techniques and technical methods of suppression, as well as meteorological situation.

12. The main divisions of forest fire services in Belarus consist of 242 fire fighting and chemical stations of two types (146 units of the first type and 96 units of the second one), as well as 648 units of fire-prevention stock. Expansion of network of fire fighting and chemical stations and units of fire-prevention stock in the forest fund of Belarus is not necessary.

13. While fighting the wildfires on the territory of Belarus the following methods are used: lashing of fire or knocking down of a flame on the fire edge; filling of the edge of the fire with soil; laying protecting and basic lines and ditches; annealing of combustible materials in front of the fire; suppression with water and fire-extinguishing chemical compositions of Metafosil and Kompleksil; suppression with the help of aircraft, which provides elimination of 67,6% of fires within 1 hour.

14. Now in connection with climate change, density and areas of radioactive pollution of the forest fund, there is a transformation in the content and the structure of the vegetation cover and, first of all, forests. The change of the structure of the forest fund, and, in particular, of the typological structure of forest plantations, which causes the change of the pyrological

characteristic of the forest fund and the class of fire hazard of the forest areas in various regions of the country, is also predicted. In this regard updating of the existing firefighting zoning of the territory of the Republic and improvement of the differentiated system of fire-prevention arrangement of the forest fund are necessary.

15. When updating the firefighting zoning it is necessary to consider a complex of climatic, soil and hydrological, the forest pyrologic, anthropogenous and other factors. To identify the complex regional indicator of potential fire hazard for forests, taking into account all legal entities conducting forestry, the analysis of the following factors was made: a class of natural fire danger, forest coverage of a zone of activity of a forestry, population density, class of radioactive pollution. These factors all together determine the need of carrying out on the territories of forest entities the same types and volumes of fire-prevention actions.

16. Forest coverage of the territory is one of the key factors, characterizing the forest fund of the country. The forest coverage in different regions of the Republic differs depending on physiographic, climatic and soil conditions. In Belarus the tendency for growth of forest coverage which in CY 2015 reached 39,5% that is 0,4% more than that in CY 2013 and 1,7% more than that in CY 2001, remains. It has been found out that the highest forest coverage is characteristic of Gomel region – 46,6%, then comes Vitebsk – 42,5%, Brest-40,5%, Mogilev – 39, 1%, Minsk –38,3% and Grodno region –37,0%.

17. Natural fire hazard of the forest fund is in direct dependence with certain types and groups of types of the forest which define the quantitative and qualitative composition of forest flammable materials, and completeness and location of forest plantations characterize conditions of maturing of flammable materials and their subsequent intensity of burning. It has been found out that the forests on the territory of Belarus are quite fire hazardous with the middle class of natural fire danger of 2,7.

So far the area of the forest lands polluted with radionuclides with a density of pollution of soil with 137Cs more than 1 Cu/km² in Belarus makes 1, 7 million hectares. The Ministry of Forestry of the Republic of Belarus has 1392 thousand hectares of forests (16,7% of total area) polluted with radionuclides. According to the results of radiation survey in CY 2015 the area of radioactive pollution of the forest fund decreased by 32,6 thousand hectares or 2,3% in comparison with CY 2014, from CY 2011 to CY 2015 – by 161,9 thousand hectares or 10,4%. From CY 2005 to CY 2015 the area of radioactive pollution of the forest fund decreased by 396,9 thousand hectares or by 22,2%.

18. The database on the level of radioactive pollution of the territory of the Republic of Belarus, forest coverage, population density of regions and natural fire hazard of forests of the forest fund was prepared.

19. The regional complex index of potential danger of origin and distribution of wildfires (P) includes the following factors: the class of natural fire hazard of forests (C), forest coverage of the region (W), inflammability of forests (I), population density of the region (P), distribution of the territory of the forest fund of the region into zones of radioactive pollution (D) and is also calculated with the formula taking into account the coefficient of their significance:

$$P = 0,4C+0,4W+0,1I+0,1\ P+D$$

20. Calculation of the complex index of potential danger of origin and distribution of wildfires on the territory of the legal entities conducting forestry in the Republic of Belarus was made. The complex index of fire danger was calculated for 98 state forestry enterprises of the Ministry of Forestry, as well as for 20 enterprises of other legal entities conducting forestry.

21. Based on the analysis of the complex indices of fire danger of the forest fund of the enterprises, as well as considering the level of anthropogenous influence on their territories taking into account the expansion of boundaries of the forest fund with settlements and their remoteness from forests, gravity of radioactive pollution and the mode of forest management division of the territory into forest fire belts is offered and three forest fire belts are selected.

22. The organizations, conducting forestry, were classified (grouped) by means of two methods of cluster analysis: the method of creation of clustering trees which is applied to find the quantity of classes and the approximate structure of classes, and K-means clustering algorithm (a method of vector quantization, originally from signal processing). As initial centers of clusters the observations maximizing initial distances between clusters were selected. For assessment of quality of clustering the values of intergroup and intra group dispersions of indices were compared.

23. In case of clustering, the organizations conducting forestry were combined taking into account the considered features, without an account for spatial situation, therefore the selected regions have the broken spatial structure (fig. 1).

24. The staticized map of firefighting zoning differs from the existing map in distribution of the organizations conducting forestry in forest fire belts (Appendix B). Thus, 49 enterprises (52 before) belong to the I forest fire belt, 40 (34) - to the II belt, 29 (27) - to the III belt.

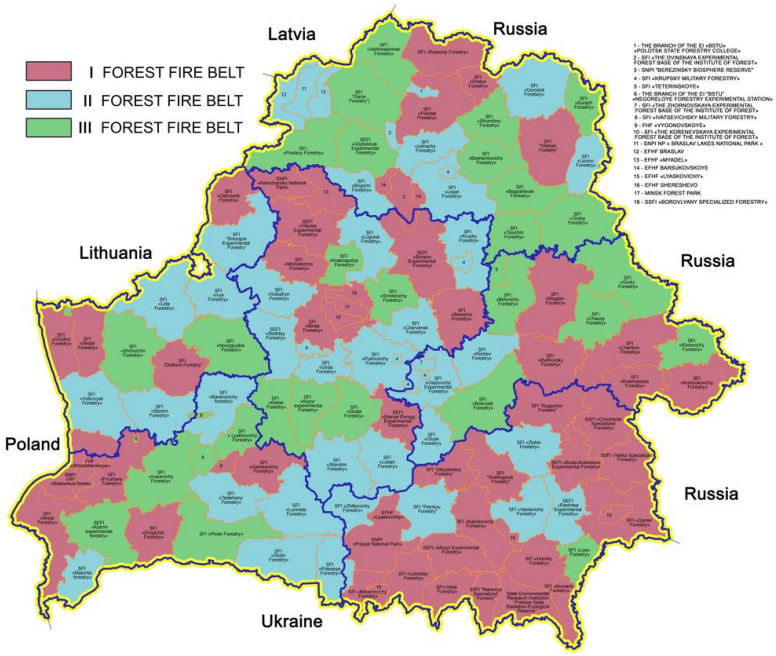


Fig. 1. The updated map of firefighting zoning of the territory of the Republic of Belarus

25. The developed recommendations on differentiation of the system of fire-prevention arrangement of the forest fund include actions for creation in the forests of the system of fire-prevention barriers in the form of barriers and gaps, the mineralized strips limiting distribution of fires in the forest, as well as the structure of a network of roads and reservoirs for ensuring expeditious delivery of services of fire extinguishing and elimination of the arising burning centers, taking into account distribution of the enterprises to forest fire belts.

26. Recommendations on updating of forest firefighting zoning are presented in the form of Amendment No. 1 to the technical code of established practice (TCEP 193-2009 (02080) " Rules of firefighting arrangement of forests of the Republic of Belarus ". Amendment No. 1 is approved by the Resolution of the Ministry of Forestry of the Republic of Belarus No. 6 as of April 28, 2017 and will be put into force on July 1, 2017. (Appendix C)

INTRODUCTION

1. One of the most urgent problems of the natural complex of the Republic of Belarus is forest prevention from fires and elimination of their consequences. Forest plantations on the territory of the Republic are quite fire-hazardous with a middle class of natural fire danger of 2,7. Despite annual carrying out a complex of preventive fire-prevention actions in the forest fund of the Republic, the use of modern means of early detection and expeditious elimination of fires, their emergence and spread is not possible to be fully prevented.

2. The problem of prevention, elimination of fires and their consequences became aggravated after the Chernobyl accident which resulted, as of 01.01.2016, 17,6% of the forest fund of the Republic were subject to pollution with radioactive substances. In these radioactively polluted forests, owing to restriction or the termination of economic activity there is an active process of accumulation of flammable materials, which raises fire danger of these forest areas and demands a specific system of actions for their protection.

3. In forest growth conditions of Belarus it is necessary to improve the differentiated system of fire-prevention actions in the forest fund for successful prevention of fires and fight against them. Implementation of the above-stated demands will allow providing ecological integrity of forest phytocenosis and keeping their nature protection and environment forming functions on the territory of the forest fund of the Republic.

4. Lately in view of the intensifying climate change influence, as well as density and the area of radioactive contamination of the forest fund, there is a transformation in the structure of a vegetational coverage, in particular the typological structure of forests, which will cause the change of the pyrological characteristic of the forest fund and the class of natural fire danger of the forest area in various regions of the country.

5. In this regard our research is aimed at the improvement of the existing system of actions for monitoring of wildfires and fire-prevention arrangement of the forest fund taking into account the updated map of forest firefighting zoning of the territory.

1. STUDY OF THE LONG-TERM DYNAMICS OF FIRES AND INFLAMMABILITY OF FORESTS IN THE FOREST FUND OF THE REPUBLIC OF BELARUS, THE REASONS FOR THEIR ORIGIN WITH ASSESSMENT OF EFFECTIVENESS OF FIRE-FIGHTING ARRANGEMENT

1.1 The analysis of the long-term dynamics of fires in the forest fund of the Republic of Belarus and the reasons for their origin

6. Fire hazard of the forest areas is determined by their pyrological characteristic which depends on typological, age and structural features of plantations.

7. The total area of the forest fund of the Republic of Belarus, as of January 1, 2016, makes 9,54 million hectares, at the same time the major part of them belongs to the Ministry of Forestry (tab. 1).

Tab. 1. Distribution of the forest fund of the Republic of Belarus

Republican state body and other state organizations	Area, ths. ha	Percent from total area
Ministry of Forestry of the Republic of Belarus	8402,1	88,0
Ministry of Defence of the Republic of Belarus	89,7	0,9
Ministry for Emergency Situations of the Republic of Belarus	216,1	2,3
Ministry of Education of the Republic of Belarus	27,6	0,3
Administration of the President of the Republic of Belarus	757,2	7,9
National Academy of Sciences of Belarus	41,5	0,4
Local Executive and Administrative Bodies	15,0	0,2
Total	9549,2	100

8. The area of the lands covered with the forest in the country is 8,2 million hectares, and the average stock of timber per 1 hectare makes 212 m³, where the mature ones – 269 m³, and mature and overmature ones of the main forest forming species – 258 m³. The average age of plantations makes 54 years, the average completeness – 0,7.

9. The species structure of forests is presented by coniferous, soft-wooded broadleaved species and hard-wooded broadleaved ones. The individual share of plantations of coniferous species on the area covered with forests makes 59,8%, including the Scotch pine – 50,5%, the European spruce – 9,3%; the soft-wooded broadleaved species – 36,1%, where the most widespread one is the Silver birch – 23,3%, the black alder – 8,5%, the aspen – 2,1%; the hard-wooded broadleaved ones – 4,1%, including the English oak – 3,5%, the ash – 0,3%, the hornbeam – 0,2%.

10. Natural fire hazard of the forest fund is in direct connection with certain types and groups of types of forests which determine quantitative and qualitative composition of forest flammable

materials, and completeness and location of plantations characterize conditions of maturing of flammable materials and their subsequent intensity of burning. The type of forests causes both formation of the main conductors of burning, and necessary conditions for emergence of wildfire at the specific site.

11. The largest square of forests of the pine formation is presented by mossy pine forests (40,7%), bracken pine forests (20,0%) and bilberry pine forests (16,1%) (tab. 2). Spruce forest stands are presented by wood-sorrel spruce forests (54,6%), bilberry spruce forests (20,2%) and bracken spruce forests (12,4%). In a birch formation the most widespread ones are those of bilberry birch forests (18,9%), ferny birch forests (16,9%), wood-sorrel birch forests (16,6%) and bracken birch forests (11,2%). In the black alder phytocenoses – spiraea forests (28,6%), ferny forests (24,2%), sedge forests (24,1%) and other forest types. In general, wood-sorrel type (14,8%), mossy type (21,6%) and bilberry type (15,3%) are the most widespread types in the Republic.

Tab. 2. Distribution of the area of the forest fund according to the forest types (the land covered with the forest), hectare

Forest type	Main wood species							
	pine (*Pinus silvestris*)	spruce (*Picea abies*)	oak (*Quercus robur*)	birch (*Betula verrucosa*)	black alder (*Alnus glutinosa*)	aspen (*Populus tremula*)	others	total
1	2	3	4	5	6	7	8	9
Lichenous (*cladinosum*)	20338	–	–	104	–	–	7	20449
Ericetal (*callunosum*)	187538	–	–	9298	–	–	32	196868
Vacciniaceae (*vacciniosum*)	12371	1358	–	1239	–	125	12	15105
Mossy (*pleurozіosum*)	1687705	34048	–	56742	–	1074	147	1779716
Bracken (*pteridiosum*)	829618	94795	26747	213149	–	12580	5380	1182269
Wood-sorrel (*oxalidosum*)	207115	417960	134586	317406	15211	74991	50001	1217271
Bilberry (*myrtillosum*)	665336	154527	54069	362749	–	20464	2414	1259559
Polytric (*polytrichosum*)	195459	12413	–	190620	–	4288	393	403173
Ledum (*ledosum*)	110035	–	–	–	–	–	6	110041
Sedge (*caricosum*)	61163	2029	–	173618	168233	–	36540	441583
Sphagnous (*sphagnosum*)	9987	–	–	229	–	–	2	10218
Sedge-sphagnous (caricoso-	148207	247	–	27508	–	–	53	176015

sphagnosum)								
Glague (*aegopodiosum*)	–	20594	26012	57931	22335	38468	89398	254738
Urticaceous (*urticosum*)	–	2427	3216	28879	85804	4796	4997	130119
Ferny (*filicosum*)	–	21137	9424	322602	169046	18625	45283	586117
Riverian-herbaceous (fontinale-herbosum)	7959	3261	–	43589	–	2056	380	57245
Meadow (*airosum*)	–	–	1747	–	–	–	3	1750
Riverian-bottomland (*fontinale-fluvialis*)	–	–	10341	–	–	–	13	10354
Gramineous-bottomland (*graminoso-fluvialis*)	–	–	9006	–	–	–	3	9009
Alder- bottomland (*Alneto fluvialis)*	–	–	4118	–	–	–	17	4135
Ash- bottomland *(Fraxineto fluvialis)*	–	–	352	–	–	–	4	356
Forbs- bottomland (*nemoroso-fluvialis*)	–	–	1704	–	–	–		1704
Bottomland *(fluvialis)*	–	–	2642	–	–	–	5193	7835
Wet moor – mixed herbs (*palustro-mixto-herbosum*)	**–**	**–**	**–**	**–**	**–**	**–**	**136**	**136**
Spiraea (*filipendulosum*)	–	–	–	–	200177	–	19152	219352
Sedge-grassy (*caricosum-herbosum*)	–	–	–	93164	–	–	132	93296
Wet moor -ferny *(palustro-thelypteridosum)*	–	–	–	10097	30643	–	105	40845
Iridaceae (*iridosum*)	–	–	–	–	5448	–	21	5469
Willow (*salicosum*)	–	–	–	613	2521	–	1831	4965
Gramineous	–	–	–	–	–	–	113	113
Total	**4142831**	**764796**	**283964**	**1909537**	**699418**	**177467**	**261768**	**8239780**

12. According to I. S. Melekhov's scale modified by I. E. Richter for climatic conditions of Belarus, the most widespread formations of the pine and spruce forests belong to the high and middle class of natural fire hazard.

13. According to species, structure and strong anthropogenous influence, forests on the territory of Belarus are potentially fire-hazardous – with middle class of natural fire hazard of 2,7. Over the last time because of various reasons (climate change, radioactive pollution of the forest fund, etc.) there is a transformation in the structure and the structure of the vegetative cover, in particular the typological structure of forests, which causes the change of pyrological characteristic of the forest fund and the class of natural fire danger of the forest area in various regions of the country.

14. Despite annual carrying out a complex of preventive actions in the forest fund of the Republic, use of modern means of early detection and expeditious elimination of fires, their emergence and spread are not possible to warn fully. On the territory of the forest fund of the Republic of Belarus for 1959-2015 there were 136 thousand fires on the total area of 206 thousand hectares, including 1,2 thousand cases of fires on the area of 16,9 thousand hectares in CY 2015 (tab. 3). The average area of one fire, which is an indicator of efficiency of its detection and elimination, made 1,58 hectares, at a minimum of 0,16 hectares and a maximum of 13,91 hectares.

Tab. 3. Dynamics of fires on the territory of the forest fund of the Republic of Belarus (1959-2015)

Year	Number of fires	Total area of fires, ha	Average area of fires, ha
1	2	3	4
1959	3450	23919	6,93
1960	2057	5765	2,80
1961	2045	5361	2,62
1962	478	289	0,60
1963	4687	10933	2,33
1964	4897	7044	1,44
1965	1209	569	0,47
1966	5417	7048	1,30
1967	2478	1264	0,51
1968	2124	729	0,34
1969	2396	2325	0,97
1970	1065	375	0,35
1971	3414	12203	3,57
1972	3766	3042	0,81
1973	2256	1479	0,66
1974	3952	3168	0,80

1975	2761	1548	0,56
1976	3681	1423	0,39
1977	1539	1267	0,82
1978	1313	515	0,39
1979	4125	2375	0,58
1980	833	207	0,25
1981	2644	1375	0,52
1982	1452	246	0,16
1983	4311	2409	0,56
1984	4883	6896	1,41
1985	1369	343	0,25
1986	2454	2881	1,17
1987	855	155	0,18
1988	1769	834	0,47
1989	1956	1045	0,53
1990	2471	1039	0,42
1991	1517	319	0,21
1992	8121	25683	3,16
1993	1887	1617	0,86
1994	3052	2469	0,81
1995	3257	5645	1,73
1996	4123	7997	1,94
1997	1466	965	0,66
1998	876	568	0,65
1999	3959	6261	1,58
2000	2569	1931	0,75
2001	1111	442	0,40
2002	5274	22282	4,22
2003	2027	4363	2,15
2004	1121	587	0,52
2005	1114	345	0,31
2006	3252	2516	0,77
2007	1079	662	0,61
2008	673	441	0,66
2009	1485	1710	1,15
2010	607	424	0,70
2011	433	156	0,36
2012	544	189	0,35
2013	272	73	0,27
2014	687	359	0,52
2015	1218	16947	13,91
Total	**135831**	**215022**	**1,58**

15. It should be noted that the decrease in the number of fires after CY 2002, which was extremely droughty for the Republic, is observed. The decrease in the area and the number of fires were promoted by work which was conducted in the SSI "Institute of Forest of the NAS of Belarus" in the field of forest prevention from fires and was aimed at improvement of means and technologies of monitoring, prevention and elimination of fires in the forest fund of the Republic of Belarus. During this period at the institute the GD RB 02080.015-2002 "The instruction for application of fireproof chemical composition of Metafosil for firefighting" was developed, in CY 2005 the STB 1582-2005 "Sustainable forest management and forest exploitation. Requirements for forest protectiont measures" and GD RB 02080.023-2005 "Practical recommendations for diagnostics of postfire condition of plantations of the main forest forming species and managing them" were developed, and in CY 2009 – TCEP 193-2009 (02080) "Rules of firefighting arrangement of forests of the Republic of Belarus ", and later the map of forest firefighting zoning of Belarus were developed. Further No. 000224 TNPA (as of 28.03.2012) "Methodical recommendations on suppression of wildfires by the annealing method" and No. 242 (as of 24.03.2014) "The technique of identification of fire hazard of forests under the weather conditions in the Republic of Belarus" were included into the register.

16. However not all problems in the field of forest fires prevention have been solved. Thus, during CY 2006-2015 in the forest fund of the Ministry of Forestry there were 8479 fires on the total area of 11729 hectares. The maximum number of ignitions (2007 cases) was observed in Gomel SFPA, where the area of the fires was maximum and made 6504,4 hectares (fig. 2).

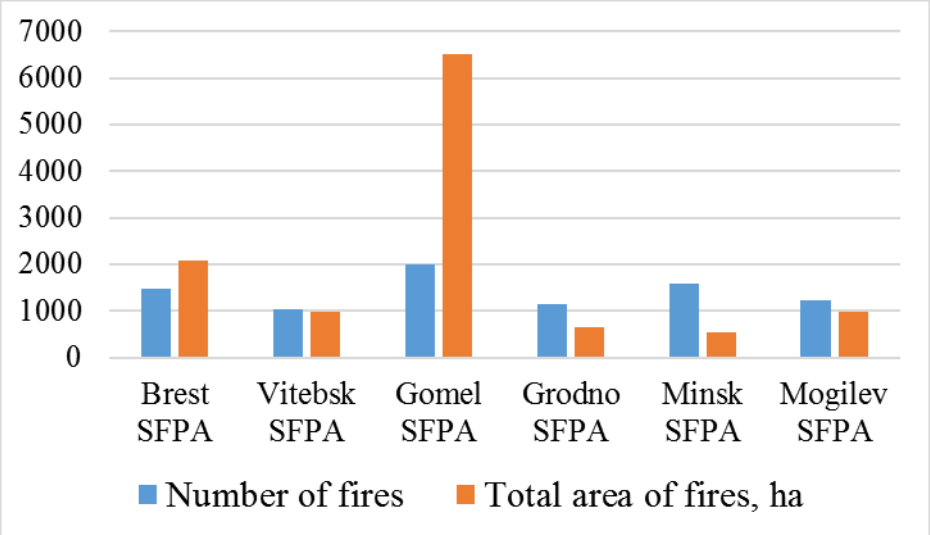


Fig. 2. Dynamics of fires in the forest fund of the Ministry of Forestry

17. The analysis of distribution of the fire area on the territories of the SFPA forest fund according to types demonstrates that the largest specific weight in the area which is undergone by fires for 2006-2015 was occupied by local fires (77,5%), the smallest one – by soil fires (1,7%), the individual share of the upper fires made 20,8% (tab. 4).

Tab. 4. Dynamics of the fire area according to types in the forest fund of the Ministry of Forestry (2006-2015)

SFPA	Number of fires	Total Area of fires, ha	Average area of the fire per 1 case, ha	Forest area undergone by fires, ha/%				Non-forest area, undergone by fires, ha
				total	including			
					Creeping fire	Crown fire	Ground fire	
Brest	1482	2087,8	1,4	2042,8 100	1454,0 4,7	493,3 24,1	95,5 71,2	45,0
Vitebsk	1029	974,9	0,9	973,1 100	910,3 3,3	30,6 3,1	32,2 93,6	1,8
Gomel	2007	6504,4	3,2	6464,7 100	4597,5 0,2	1853,1 28,7	14,1 71,1	39,7
Grodno	1147	635,8	0,6	633,6 100	616,1 1,5	8,0 1,3	9,5 97,2	2,2
Minsk	1579	547,0	0,3	534,0 100	486,3 8,1	4,7 0,9	43,0 91,0	13,0
Mogilev	1235	979,1	0,8	950,5 100	919,5 0,3	28,5 3,0	2,5 96,7	28,6

18. The analysis of spread of fires for the reasons of their emergence on the territory of the forest fund of the Republic of Belarus for 1975-2015 shows that the largest quantity (70,7%) of them occurred because of the general public, while 6,8% is the share of agricultural burning, and for the unspecified reasons – 22,5% (tab. 5).

Tab. 5. Distribution of fires according to the reasons of their emergence in the forest fund of the Republics of Belarus (1975-2015)

CY	Identified reasons for emergence of fires, number of cases		Unidentified reasons, number of cases
	population fault*	agricultural burning	
1975	2353	145	263
1976	3296	192	193
1977	1471	28	40
1978	1264	19	30
1979	4013	45	67
1980	777	22	34
1981	2461	45	138
1982	1418	8	26
1983	4065	22	224

1984	4315	269	299
1985	1255	38	76
1986	2203	69	182
1987	802	22	31
1988	1457	101	211
1989	1701	60	195
1990	2173	215	83
1991	1288	153	76
1992	4391	751	2979
1993	834	112	941
1994	1765	98	1189
1995	1952	177	1128
1996	2219	544	1360
1997	707	128	631
1998	491	113	272
1999	2499	285	1175
2000	1573	132	864
2001	673	103	335
2002	3171	659	1444
2003	1364	223	440
2004	809	119	193
2005	771	61	282
2006	1827	665	759
2007	559	67	453
2008	306	45	322
2009	740	209	536
2010	229	40	338
2011	137	14	282
2012	126	49	369
2013	48	8	216
2014	76	29	582
2015	144	44	1030
Total	63723	6128	20288
Note – * This category also includes the fires which arose because of forest operators, expeditions and other organizations			

19. Agricultural burnings on various categories of lands, including those which were not mown, as well as pastures, fields adjoining borders of the forest fund, were in definite years the serious reason for many wildfires in the Republic, and their share made from 0,5 to 20,5% in various years. Only unique cases of emergence of wildfires on the territory of Belarus in definite years were caused by natural sources of ignition – lightnings. It is also necessary to note that if for 1975-1990 the reasons for fires only in 5,4% of cases annually were not identified, then for 2006-2015 this percent grew, unfortunately, up to 47,7% (fig. 3).

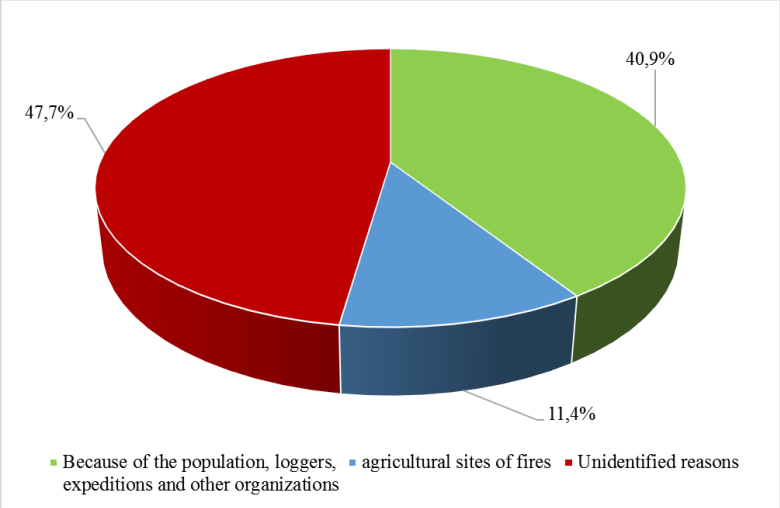


Fig. 3. The reasons for fires in the forest fund of the Republic of Belarus (2006-2015)

20. At the same time the cross-border fires can do special harm, which became notable in extremely fire-dangerous CY 2015 when the number of fires sharply increased in comparison with previous years.

21. It is necessary to note that in May, 2013 at the meeting of the Council of CIS State Leaders in Minsk Agreements on prevention and suppression of natural fires on border territories of the State Parties of the Commonwealth of Independent States were signed; and in November of the same year the Council of the Republic of the National Assembly of Belarus voted for ratification of this document. The main goals of the Agreement were: to reduce the damage caused by fires, to render mutual aid and exchange of experience on fight against natural fires, as well as to interact on prevention and suppression of fires. It is provided in the Agreement that the parties establish, on the territory of each State Party, a zone of joint protection of the territory from natural fires. At the same time Ukraine didn't participate in signing of these agreements and the bilateral contract on prevention and there is no agreement on suppression of natural fires at border territories between Belarus and Ukraine now.

22. In general on the territory of Belarus in CY 2015, 1218 fires on the area of 16947 hectares (tab. 6) were recorded. Their greatest number arose in Polesye State Radiation-Ecological Reserve (hereinafter - PSRER) and on the territory of forestries belonging to the Ministry of Forestry. In forests belonging to the Ministry of Forestry, following the results of this fire-dangerous season, 1042 cases on the area of 6414 hectares were noted (the largest areas, damaged by fire, were recorded in Gomel region – 4522 hectares). At the same time the area of the cross-border fires which came from the territory of Ukraine made 3699 hectares. In the forests belonging to the forest fund of the Ministry for Emergency Situations (on the territory of PSRER), the fire area made more than 10 thousand hectares (62% of the total area of wildfires in Belarus).

Tab. 6. Distribution of the area which was undergone by fires in 2015, according to state bodies, hectare

Republican body of public administration and other state organizations	Area of forest lands, undergone by fires	Area of non-forest lands, undergone by fires	Total area undergone by wildfires
Ministry of Forestry of the Republic of Belarus	6356	59	6414
Ministry of Defence of the Republic of Belarus	14	–	14
Ministry of Education of the Republic of Belarus	1	–	1
Ministry for Emergency Situations of the Republic of Belarus	7366	2793	10159
National Academy of Sciences of Belarus	5	–	5
Administration of the President of the Republic of Belarus	128	219	348
Local Executive and Administrative Bodies	7	–	7
Total	**13876**	**3071**	**16947**

23. Among the reasons for such increase in the number of fires is the fact that recently the fire-hazardous period increased on average for 60 days. Just a few decades ago the burning season lasted 160–190 days and was within the time frames specified in fire safety regulations – from April 1 to October 30. In this regard, if there were earlier fires, patrol work began late, and the first fires were noted in March (tab. 7). Thus, only in spring the aircraft didn't find a considerable part of the arisen fires.

Tab. 7. Dates of the first and the last fire in the forest fund of the Ministry of Forestry

SFPA	2011	2012	2013	2014	2015
	Date of the first fire – date of the last fire (day.month)				
Brest	19.04-05.10	17.03-19.09	30.04-18.09	05.04-19.11	18.03-21.10
Grodno	–	25.03-29.09	25.04-10.09	11.03-05.11	28.03-15.10
Vitebsk	23.04-07.08	30.04-13.09	07.05-11.09	03.04-11.10	12.04-31.08
Gomel	20.04-27.09	23.03-16.09	23.04-22.08	14.03-04.11	19.03-29.10
Minsk	22.04-21.09	27.04-18.09	01.05-01.09	21.03-01.11	27.03-17.10
Mogilev	04.04-06.09	15.04-14.09	09.05-22.08	30.03-11.10	15.03-05.10

24. Besides, the percent of fires detected by RUE "Bellesavia" in 2015, in comparison with 2014, was cut almost by half. One of the reasons is lack of funds which affected technical conditions of aircrafts, as well as procurement of fuel. At the reduction of flights the efficiency of detection of wildfires decreases, which leads to formation of major fires. Nevertheless, at the plan of 1700-hour raid, the raid of RUE "Bellesavia" for a fire-hazardous season made 2300 hours.

25. On average for the five-year period from all detected fires 46% were detected and 9,8% were liquidated by means of aircraft. The small percent of elimination is explained by the fact that generally all centers are extinguished at an early stage. It is promoted by patrol works of aircraft and video surveillance.

26. The economic component, in general, plays the predominating role, equipment availability and its novelty, staff provision and their qualification depend on it. Costs of forest protection and fight against wildfires are heavy and tend to grow. Fire-fighting is a serious item of expenditure of the forestry branch. It is necessary to mention that aviation patrol work is the most expensive way of detection and suppression of wildfires. The funds allocated for forest prevention from fires often don't compensate all necessary expenses.

27. Successful prevention of fires and fight against them in forest vegetative conditions of the Republic require improvement of the differentiated system of fire-prevention actions in the forest fund. Besides, as it was in 2015, issues of prevention and elimination of cross-border fires need to be solved not only within the framework of the Republic but also together with neighboring states. Implementation of above-mentioned requirements allows for providing ecological integrity of forest phytocenosis and keeping their nature protection and environment forming functions on the territory of the forest fund of the Republic.

1.2 Assessment of inflammability of forests on the territory of the Republic of Belarus and assessment of effectiveness of their fire-fighting arrangement

28. The forest performs three functions at the same time: resource function, protective function and a social one. If the possibilities of the forests are limited, the needs for their useful functions increase steadily. Forest resources are renewable and if approached rationally their use becomes continuous in time.

29. The correct organization of fire-prevention arrangement and effective fight against wildfires requires division of a large territories into parts (forest fire areas) which are homogeneous according to the whole complex of climatic, typological, forest pyrologic, forestry, forestry industry, economic and some other factors which in the whole determine approximately identical types of fire-prevention actions with identical expenses of forces and funds for their realization.

30. The usage of the territory is connected not only with the land relief, intensity of forest management, but also with the population density expressed by the relation of a number of people, living on a certain territory.

31. Owing to the age and species structure, strong anthropogenous influence, forest plantations on the territory of Belarus differ in high fire hazard and inflammability. inflammability of the forest fund is in most cases caused by careless handling of fire by the public, especially in places of congestion or expected rest.

32. The greatest population density is a characteristic feature of Minsk region, the smallest one is a characteristic of Vitebsk (tab. 8). It should be noted that the highest density of fires, determined by the relation of the number of wildfires to the unit of the forest area in a fire-hazardous season, is noted in Gomel (0,476) and Brest (0,437) regions, and the smallest one – in Vitebsk region (0,098). At the same time the average duration of a fire- hazardous season for Gomel and Brest regions makes 212 days, and for Grodno and Vitebsk – 191 and 196 days respectively.

Tab. 8. Density of wildfires on the territory of Belarus (2011-2015)

Region	Territory, ths. km^2	Population density, person/km^2	Territorial density of forests	Average duration of fire-hazardous season, days	Density of wildfires
Brest	32,8	44,4	0,430	212	0,437
Vitebsk	40,0	32,7	0,467	196	0,098
Gomel	40,4	37,0	0,562	212	0,479

Grodno	25,1	45,2	0,394	191	0,275
Minsk	40,2	80,8	0,426	210	0,379
Mogilev	29,1	39,8	0,429	217	0,279

33. It is necessary to note that in a case with cross-border fires of 2015 one of difficulties at suppression of wildfires was because of low-density of population of the border Belarusian territory and dense population from the Ukrainian side.

34. The indicator of usage of the territory also consists of costs of forest management including forest prevention from fires. One of the major links here is fire-prevention arrangement of the territory of the forest fund. The basis of fire-prevention in forests of the Republic is restrictive actions for spread of fire and first of all the creation of fire-prevention barriers (fire-prevention gaps, mineralized protective strips, networks of roads).

35. Within CY 2011-2015 annual costs of fire-prevention arrangement of the territory of the forest fund of the Ministry of Forestry averaged 471 thousand US Dollars, at average inflammability of 0,1603 (tab. 9). The maximum average inflammability for this period is noted in Gomel SFPA (0,55786), and the minimum - in Grodno SFPA (0,01698). Inflammability of forests is determined as a ratio of the area which is undergone by fires (hectare) to a unit of area of forest lands (one thousand hectares).

Tab. 9. Indicators of inflammability and efficiency of fire-prevention arrangement of the SFPA forest fund of the Ministry of Forestry (2011-2015)

Year	Area of forest lands, ths. ha	Costs of fire-prevention arrangement of the forest fund		Area, undergone by fires, ha	Inflammability
		mln. rub.	USD ths		
1	2	3	4	5	6
Brest SFPA					
2011	1098,8	2460	328,0	29,3	0,0267
2012	1098,5	4309	502,8	52,6	0,0479
2013	1098,9	4576	481,2	5,8	0,0053
2014	1106,3	7017	499,8	29,9	0,0270
2015	1106,8	7356	396,1	1353,9	1,2233
Vitebsk SFPA					
2011	1295,5	2364	315,2	11,7	0,0090
2012	1299,2	3625	423,0	5,9	0,0045
2013	1299,2	3923	412,5	2,8	0,0022
2014	1299,6	5373	382,7	20,4	0,0157
2015	1498,2	7151	385,1	97,4	0,0650
Gomel SFPA					
2011	1651,1	3762	501,6	23,1	0,0140
2012	1662,1	7363	859,2	14,8	0,0089
2013	1665,1	7525	791,2	7,0	0,0042
2014	1676,6	10744	765,2	124,6	0,0743

2015	1682,3	15252	821,4	4521,8	2,6879
Grodno SFPA					
2011	856,5	2662	354,9	11,2	0,0131
2012	857,4	3774	440,4	15,0	0,0174
2013	861,4	4228	444,6	5,8	0,0067
2014	863,3	6307	449,2	14,6	0,0169
2015	863,3	7571	407,7	26,6	0,0308
Minsk SFPA					
2011	1394,1	3784	504,5	15,4	0,0110
2012	1394,2	6541	763,2	21,7	0,0156
2013	1394,1	6380	670,9	7,3	0,0052
2014	1391,2	8472	603,4	38,4	0,0276
2015	1389,7	10971	590,8	70,9	0,0510
Mogilev SFPA					
2011	1125,3	987	131,6	26,8	0,0238
2012	1128,1	1799	209,9	18,4	0,0163
2013	1140,5	2067	217,3	21,9	0,0192
2014	1140,2	3832	272,9	40,8	0,0358
2015	1140,7	4124	222,0	345,2	0,3026

36. On SFPA territories from CY 2011 to CY 2015 costs of fire-prevention actions increased by 1,2–1,5 times, at the same time inflammability of forests remains high. So, in the forest fund of Gomel SFPA in CY 2011 costs of fire-prevention arrangement made 501,6 thousand USD, and inflammability of forests – 0,014. In CY 2015 expenses increased to 821,4 thousand USD, which didn’t prevent from cross-border fires and inflammability of forests increased and made 2,6879. In this connection the decision on fire-prevention arrangement of border zones was made.

37. Thus, despite the increase of costs of fire-prevention arrangement during the last five years in the forest fund, the forest area which was undergone by fires and inflammability of forests remain high, which proves the need of enhancement of the system of fire-prevention arrangement of forests, especially in the border zone, and also updating of forest firefighting zoning of the Republic. That's why we, on the base of the books of the accounting of wildfires, developed the database of fires in the forest fund of the Republic of Belarus for the period from 2001 to 2015, including information on wildfires at the specific area: forestry enterprise, forestry unit, quarter, compartment, fire origin time, cause of a fire and area.

2. ASSESSMENT OF THE EFFECTIVENESS OF MEANS AND METHODS OF FIRES DETECTION AND ELIMINATION, ACTIONS FOR FIRE-FIGHTING ARRANGEMENT OF FORESTS IN THE REPUBLIC OF BELARUS

2.1 Forest fires monitoring

38. Now on the territory of Belarus monitoring and forecasting of forest fires is carried out according to STB 1408-2003 "Safety in emergency situations. Monitoring and forecasting of wildfires". The system of detection of wildfires is based on implementation of:

- land monitoring,
- remote visual monitoring,
- remote video monitoring,
- aviation monitoring
- space monitoring.

39. The choice of a method of detection of wildfires is caused by woodiness of the territory and the availability of objects of economic activity, population density, land relief, existence and condition of transport ways, the area of a zone of service of forest fire services, the number of the available forces and fire extinguishing means. The existing system of detection of wildfires in the forest fund of Belarus is carried out by workers of the state forest protection with a total number of 13458 people (as of 01.01.2016).

40. Land monitoring is carried out by forces of the state forest protection, routes and terms of land patrol are determined by a class of natural fire hazard of forests, a class of fire hazard of forests under the terms of weather and a degree of anthropogenous burden of territories of the legal entities conducting forestry.

41. For land patrol in the Ministry of Forestry various technical means are used: bicycles (2515 units), motorcycles of various brands and models (2210 units), special cars (871 units) and other means (461 units), generally UAZ, GAZ, VAZ and cartage (818 horses).

42. As of 01.01.2016 the park of fire trucks of forestries made 454 units. It is 28,6% higher than the established norm, however, judging by the CY 2015, this quantity was insufficient. In this regard, at the expense of a loan of the International Bank of Reconstruction and Development under the "Belarusian Forestry Development Project" CY 2016 the specialized machinery for equipping of the forest fire service was procured: 8 fire trucks on the basis of the MAZ chassis and 31 cars of cross-country capacity for forest protection. Besides, according to the order of the President of the Republic of Belarus, the Ministry of Defence

gave 20 TG-MU tracked chassis to forestries for suppression of wildfires in hard-to-reach spots (fig. 4).

Fig. 4. Military all-roader

43. Remote visual monitoring is carried out on the basis of the use of the available network of fire and observation towers (FOT-25, FOT-30, FOT-35, FOT-40) equipped with azimuthal circles which allow defining more precisely the location of the site of a fire, and masts (FOM-1, FOM-2). The area of the forest fund, observed from each tower or a mast, makes 8–15 thousand hectares. Monitoring of fires is made on the basis of use of 463 fire and observation towers and 70 fire and observation masts (as of 01.01.2017), 343 observation posts are equipped with systems of video surveillance. At the same time in 2016 forestries constructed 28 fire and observation towers and masts, 7 were written off.

44. Remote video monitoring of wildfires is carried out by means of 343 remotely operated video cameras with a radius of view up to 20 km which are set on the fire and observation towers and masts, towers of mobile operators and TV channels and other high-rise constructions of different types. For January 1, 2014 in the system of the Ministry of Forestry 160 systems of video surveillance were installed. Thus, for this period for earlier detection of wildfires there was an increase in equipment of video surveillance by 34,2%.

45. For prevention of wildfires on the territory of the country the creation of a single automated information system of tracking and early detection of fires by distant methods with the use of means of video surveillance on the basis of the all-republican system of high-rise constructions providing isolation of circuits of observation in the forest fund is carried out. So, within the State Scientific and Engineering Program (hereinafter – SSEP) "The Forests of Belarus: Productivity, Stability, Effective Use" in 2013 in Stolbtsovsky forest entity the experimental sample of a basic segment of the automated system of tracking and early detection of fires was created and training of a staff for further operation with a hardware and software system of the automated system was organized. Throughout the fire-dangerous period this

complex of the basic segment functioned both in the normal mode, and in the mode of carrying out test and full-scale tests.

46. Based on the results of conducting tests, finishing of the hardware and software system of the experimental sample of the basic segment was carried out and corrections and an algorithm of decision-making "about recognition of a fire on a smoke trail" were made. At the same time to increase the reliability of the automated system, developed for forestry institutions, a series of full-scale tests of the experimental sample will be continued. It will allow increasing the efficiency of a hardware-software complex of the experimental sample of the basic segment, realizing its upgrading to a prototype and defining the most ergonomic conditions of interaction of the human machine interface in case of the solution of the task of tracking and early detection of wildfires.

47. Now in Stolbtsovsky forest entity implementation of the already-made industrial sample of the automated system of tracking and early detection of wildfires shall be carried out. It is necessary to state that following the results of operation in 2016 its unstable operation was noted. In order to compare the efficiency of work of the domestic sample with the Russian analog in Kalinkovichsky forest entity it was planned in 2016 to set a wood monitoring system for early detection of wildfires "Forest Patrol".

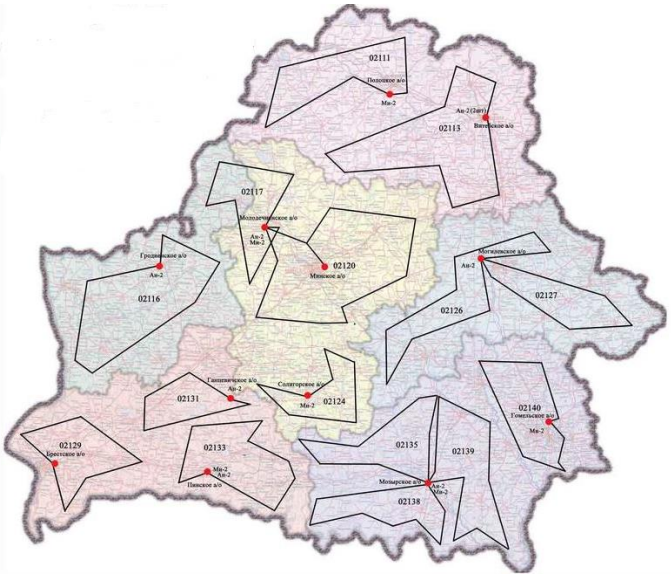
48. In this regard at this stage all SFPAs jointly with RUE "Belgosles" develop the action plan for creation of a system of tracking and early detection of wildfires by distant methods with the use of means of video surveillance on the basis of PNV and PNM which are available in the branch, towers of telecom operators and other high-rise constructions to provide isolation of circuits of observation in the forest fund (till CY 2020).

49. On the territory of the forest fund the space method of monitoring of wildfires, which allows providing data acquisition about the origin of fires and their consequences, was used.

50. Aviation forest protection is a component of the general complex of actions for forest prevention from fires which are carried out by the Ministry of Forestry of the Republic of Belarus, other legal entities conducting forestry. The main objective of aviation forest protection from fires is carrying out aviation patrol – systematic observation from air of the forest territory of the Republic of Belarus for timely detection and participation in suppression of wildfires (The Resolution of the Council of Ministers of the Republic of Belarus dated October 20, 2009 No. 1366 "On Amendment to the Resolution of the Council of Ministers of the Republic of Belarus as of March 16, 2006 No. 362"). Patrol routes for one - two - and triple patrol, respectively for small, average and high fire hazard in the forest under the terms of weather are established by the aviaoffice. The mode of patrol is carried out, in dependence on a class of fire hazard of forests

under the terms of weather, according to regulations, stated in FSR 2.38-2010 "Fire safety regulations in forests of the Republic of Belarus".

51. 15 aviaroutes are determined by the Scheme of aviapatrol of forests of the Republic of Belarus (fig. 5). The examined area about 90% from the total area of the Republic of Belarus. The Ministry of Forestry in coordination with other legal entities conducting forestry annually till May 1 identifies a zone of aviation forest prevention for the next year – borders of the protected areas of territorial authorities of the Ministry of Forestry and other legal entities conducting forestry.



– home airfield; —— – patrol route; 02120 – numbers of routes patrol; Mi-2-aircraft type

Fig. 5. Scheme of routes of aviation patrol

52. At the moment the issue of forest aviation is resolved within the reorganization of RUE "Bellesavia". According to the Decree of the President of the Republic of Belarus as of February 16, 2015 No. 67 the task of aviation forest prevention and aviation detection of fires on peat bogs are entrusted to the Public aviation rescue institution "Aircraft" by accession of RUE "Bellesavia" to it. The decision on the creation of SAERI "Aviation" of the Ministry for Emergency Situations of the Republic of Belarus was adopted in 2002. At the same time the experience of functioning of saving departments of Ukraine and the Russian Federation was considered. The airfield Lipki became the SAERI "Aviation" base. The park of the enterprise was made by the aircraft and special equipment, transferred from the Ministry of Defence of the Republic of Belarus. The park of aircraft of the enterprise consists of the helicopters AS-355, Mi-2, Mi-8, Mi-17, Mi-26, planes An-2, Il-103.

53. It is planned that reorganization will lead to strengthening of forest aviation with larger helicopters. The aircrafts, involved in protection of frontiers, will be able to conduct patrol.

However before reorganization the staff of RUE "Bellesavia" included 310 experts, and the personnel structure of the reorganized division of SAERI "Aviation" included 250 people.

54. In Canada the aviation forest patrol has 600 crafts, in the USA – 450, more than 200 are in Australia, in Southern Korea – 70, including 30 Ka-32 helicopters with the water drain device.

55. Efficiency of aviation forest prevention in Belarus is rather high. On average for the five-year period by means of aircraft 46% of all fires were identified and 9,8% of them were liquidated (tab. 10). The small percent of elimination is explained by the fact that generally all centers were extinguished at an early stage. It is promoted by patrol of aircraft and video surveillance.

Tab. 10. The number of the arisen, found and extinguished wildfires with application of aircraft on the protected territory (2010-2015)

Year	Fires on protected territories, number	Fires found		Fires liquidated with application of aircraft	
		Number	%	Number	%
1	2	3	4	5	6
2010	620	287	46	62	10
2011	450	190	42	37	8
2012	558	286	51	55	10
2013	278	179	64	46	16
2014	581	253	43	42	7
2015	1063	274	26	72	7
Total	**3550**	**1469**	**41**	**314**	**9**

56. In connection with structural reorganization of forest aviation, the scheme of financing will change. It is planned that it will become only budgetary though the article "the services connected with forestry and logging (services in aviation forest protection, services aerophoto-forest-arrangement, services in protection of forests against fires)" is provided in the list of the paid services provided by SAERI "Aviation". The raid of hours will be increased to 2500 hours, and if necessary – to 3000 hours. It should be noted that experience of RUE "Bellesavia" has shown a possibility of calculation of the budget for two options. The first option – according to classes of fire danger, at the same time we considered how many days a year constituted the share of each class of fire danger, frequency rate of flights for each of classes and a day raid across the whole territory. The second option – according to an average annual raid for the last 5–10 years, but it turns out to be higher than it was calculated (about 3000 hours).

57. It should be noted that goals of SAERI "Aviation" are various. In their framework fire investigation and suppression of fires makes only a small share of the scope of works.

58. The use of air drones in the system of the Ministry for Emergency Situations, as well as in the system of the Ministry of Forestry can be of help for further improvement of aviation forest protection. Such drones (fig. 6), are already used in the national economy of the Republic.

Fig. 6. Air Drone

59. For the first time in the system of forestry of Belarus a drone was used in 2014 with the purpose to assess damage caused by the wildfire in Osipovichsky experimental forest entity. From a drone equipped with a camera and the GPS receiver aerial photography for a binding of the received aero photographic materials to a geographical coordinate system was taken. In the conditions of constant cloudiness the drone made shooting of a part of the territory of Tselsky forestry unt where the fire was detected previously, and revealed the new center of ignition, which shows relevance of monitoring by means of the air drones on potentially dangerous territories. Operations were made by employees of SERUE "Geographic information systems" of the NAS of Belarus together with employees of the department of remote sensing and monitoring of forests of RUE "Belgosles".

60. In 2015 possibilities of the drones were shown at the republican seminar of the Ministry of Forestry in Gomel forest entity. Special attention was paid to the quadcopter which is capable to raise to the height of 500 meters and is so simple in control that foresters, in case of bypass of the forest, can use it.

61. The long-term analysis (from 2002 to 2015) of fire areas by the moment of their detection in the forest fund of the Republic demonstrates that more than a half of the fires (56,7%) had the area to 0,05 hectares, at the same time the smallest percent of the fires, – 3,2% was characterized

by more than 1 hectare (tab. 11), and 82,9% of the fires had the area up to 0,10 hectares, which testifies almost timely efficiency of their detection.

Tab. 11. Spread of the number of fires on the area at the time of detection in the forest fund of the Republic of Belarus (2002-2015)

Area of fires, ha	Number of fires, %
Up to 0,05	56,7
0,06–0,10	26,2
0,11–0,50	10,2
0,51–1,00	3,7
More than 1 ha	3,2

62. Thus, introduction of modern methods and means of early detection, prevention, suppression of fires and elimination of their consequences into the practice of forest protection will allow reducing the area of wildfires on the territory of Belarus, the material and ecological damage caused by them, keeping nature protection and environment forming functions of the forests.

2.2 Analysis of the effectiveness of means and methods of forest fires elimination

63. One of the major links in the organization of forest protection from fires is also fire-prevention arrangement of the territory of the forest fund including the whole complex of organizational and technical and preventive actions for the prevention of emergence and spread of fires, expeditious detection of centers of ignition and their suppression taking into account specifics of forest protection in radiocontaminated zones.

64. Prevention and elimination of fires and their consequences are among the most urgent and major tasks for forestry of the Republic of Belarus. In accordance to the normative legal acts existing now, the leading place in forest protection from fires is taken by the actions aimed at prevention of emergence of wildfires, restriction and minimization of their negative impact (STB 1582-2005 "Sustainable forest management and forest exploitation. Requirements for forest protection", TCEP 193-2009 (02080) "Rules of fire-prevention arrangement of forests of the Republic of Belarus", GD RB 02080.023-2005 "Practical recommendations on diagnostics of a postfire condition of plantations of the main forest forming species and maintaining economy in them".

65. Despite the use of modern means for forest fire prevention for the last decade, fires annually and, in particular, during extremely fire-dangerous seasons, lead to death or damage to forest plantations on quite large territories.

66. Overall performance of forest fire services substantially depends on the equipment with special fire extinguishing means, transport and communication on which duration of suppression and the fire area by the time of localization depends.

67. The positive tendency of the last years, with the exception of abnormally fire-hazardous CY2015, in forest prevention from fires took place thanks to the system of the organizational and technical actions aimed at immediate reaction to the emergence of ignitions, their localization and suppression. The central place in the system of forest prevention is taken by preparation for a fire-dangerous season. It is effectiveness of detection and organization of suppression of wildfires that depends on it. Quality and timeliness of this preparation are observed by experts of the Ministry of Forestry, RUE "Belgosles", and also representatives of regional associations. As a result, all forestries of the branch undergo testing for readiness for a fire-dangerous season.

68. For assessment of readiness by the State forest protection in all forestries the reviews are made, as well as demostration-practical maneuvres. All the special and converted (into special) equipment, the equipment used for detection and suppression of wildfires is ready by March 01.

69. In the system of forest prevention preparation for a fire-dangerous season takes an important place. Effectiveness of detection and suppression of wildfires depends on whether it is made in due time and fully.

70. The main divisions of forest fire services of Belarus are fire fighting and chemical stations (FFCS) of two types: the first (FFCS-1) and the second (FFCS-2), as well as the units of fire-prevention stock (UFPS) in forestries which don't have FFCS.

71. FFCSs-1 are created in forestries and are equipped with necessary means of fire extinguishing according to the Provision on fire fighting and chemical stations. The task of FFCSs-1 is elimination of centers of ignitions on the territory of the forest fund up to 20 thousand hectares.

72. FFCSs-2 are created at the legal entities conducting forestry, other organizations and are equipped with fire extinguishing means. The task of FFCSs-2 is elimination of centers of ignitions on the territory of the forest fund over 20 thousand hectares, and also assistance of FFCSs-1 in suppression of the major forest and peat fires in the forest fund of the relevant legal entity conducting forestry and other organizations.

73. Functioning of FFCSs is carried out according to the provision on fire fighting and chemical stations, stated in FSR 2.38-2010 "Fire safety regulations in forests of the Republic of Belarus".

74. By the beginning of a fire-dangerous season of 2016 in the system of the Ministry of Forestry 253 fire fighting and chemical stations and 657 fire-prevention stock were functioning. In comparison with 2015 there was an increase in FFCS for 9 stations, and UFPS - for 8 points. At the beginning of 2014 the quantity of FFCS made 243 and UFPS – 651.

75. Various soil-cultivating tools, cars and mechanisms are used for localization of fires by laying of the protecting mineralized strips: a milling patch-layer PF-1, a milling forest fire unit ALF-10, ploughs of various brands and models (PKL-70, PKL-70A, PD-0,7, PLP-135, PLSh-1,2, PDP-1,2, PLP-1, L-134, etc.), GT-3 soil thrower, forest fire tractor TLP-4M, PL U049 plough mill in the unit with the MTZ-1221 tractor). As technical means on soils of various mechanical structure without stony inclusions GT-3 soil thrower, a milling unit forest fire ALF-10, PL U049 plow mill in the unit with the MTZ-1221 tractor and other specialized cars and mechanisms are used for active suppression of the edge of the ground fire.

76. Suppression of larger sites of forest fire is carried out with the use of fire trucks and fuel trucks of various brands and models (on the basis of the chassis of the MAZ, ZIL, URALS, GAZ cars, etc.), mobile capacity for water on the wheel run (RZhT-3, RZhU-3,6, RZhT-4M, RZhT-6M, RZhT-8, etc.), removable tanks of various models and other reservoirs for water of various capacity (RDV-12, RDV-30, RDV-100, RDV-1500, etc.). Now for water supply from water sources to the sites of fire, motor-pumps of various brands and models are widely used (generally the HONDA brands).

77. For laying protecting fire-prevention strips of 6-10 m wide including those for care of fire-prevention gaps, the plough mill PL of forest suspended one U049 in the unit with the MTZ-1221 tractor is used.

78. For the start of annealing from basic strips the figurative incendiary devices of wick and drop type filled with petrol-oil mixture (AZ-1, AZR-5B, ZA-FKT, AZ-4 Yermak), and also other incendiary devices (blowlamps) are used.

79. Water is the main fire extinguishing substance for suppression of wildfires. Depending on the type and intensity of a fire, weather conditions, existence of water-supplies, fire fighting equipment, problems of localization of a fire, and in some cases its full suppression, are solved with the use of the fire extinguishing means. Water for suppression of fires is used from rivers, lakes, streams and other water sources which are close or imported in fire trucks and fuel trucks from near sources: (ATs-30(66)-184, ATs-30(5434), ATsL-10(6611), ARS-14(131), ATs-30(3307), ATs-30(66)-146, ATs-30(53A)-106B, ATs-40(130), ATs-40(375), etc.), tanks of special forest fire units (VPL-149, TLP-4M), mobile capacities for water on the run (RZhT-3, RZhU-3,6, RZhT-4, RZhT-6M, RZhT-8), removable tanks of different types and other capacities not less than 0,7 m3 (RDV-12, RDV-30, RDV-100, ZZhV-1,8, RDV-1500 and P-1).

80. The water means of suppression of fires is most widely applied in fight against ground fires of various intensity and soil fires. Suppression of small fires is made by forest fire extinguisher cylinders of backpack type: BFFE-M, OP, OPX-3 and ORM-1. The most widespread backpack cylinder forest fire extinguisher for suppression of wildfires is BFFE "YERMAK". Suppression of large sites of forest fire is carried out with the use of fire trucks and fuel trucks: (ATs-30(66)-184, ATs-30(5434), ATsL-10(6611), ARS-14(131), ATs-30(3307), ATs-30(66)-146, ATs-30(53A)-106B, ATs-40(130), ATs-40(375), etc.), tanks of special forest fire units (VPL-149, TLP-4M), mobile capacities for water on the run (RZhT-3, RZhU-3,6, RZhT-4, RZhT-6M, RZhT-8), removable tanks of different types and other capacities not less than 0,7 m3 (RDV-12, RDV-30, RDV-100, ZZhV-1,8, RDV-1500 and P-1).

81. In practice of suppression of wildfires the small forest fire modules consisting of the container of 700-1500 liters with water (solution of the fire extinguishing chemical compositions) and the motor-pumps generally put on UAZ and GAZ cars of various models, as well as other technical means were widely used. Forest fire modules quickly reach places of forest fire, which area, by the time of detection in most cases (82,9%), makes up to 0,1 hectares, which provides their fast elimination. The forest fire module is installed on the vehicle only for the period of a fire-dangerous season, and in other season it can be used for general economic purposes.

82. Suppression of small fires is made by forest backpack sprayers and fire extinguisher cylinders, in the main by BFFE RP-18 "Yermak", and also by BFFE-M, BFFE-6, OR-1, ORH-ZM, OLU-16.

83. Fire fighting and chemical stations and stations of fire-prevention stock are equipped with fire trucks and fuel trucks, special gears and the equipment. In the system of the Ministry of Forestry, at FFCSs and UFPSs there are 454 fire trucks and fuel trucks, 1655 motor-pumps of various productivity, 339 forest fire modules, 966 ploughs of various models, 11860 forest backpack sprayers and fire extinguisher cylinders, 301 km of fire hoses, 312 air blowers, 2370 incendiary devices, 44 soil throwers, 992 motor saws, 700 reservoirs for water of various capacity, 1196 hook-on systems and capacities, 374 mobile tanks for water on the wheel and other fire extinguishing means (as of 01.01.2016). At the same time the quantity of motor-pumps exceeds the norm for 2,4%, hook-on tanks and tanks for 82%, backpack forest fire extinguisher cylinders for 4,4%.

84. For strengthening of material and technical resources of forestries in 2016 at the expense of means of a Loan of the International Bank for Reconstruction and Development 8 fire trucks and 31 cars of cross-country capacity for forest protection were purchased. Besides, the Ministry of Defence donated 20 GT-MU tracked chassis for suppression of fires in hard-to-reach areas.

According to the signed document by the head of the state, 76 of the fire trucks will be transferred to forest entities by the Ministry for Emergency Situations on a grant basis

85. In due time, in 2014 enterprises of the branch procured backpack forest fire extinguisher cylinders – 538 pieces (160% of the planned quantity), fire pressure delivery hoses – 15,35 thousand running meters (189%), motor-pumps – 10 items (200%), air blowers for water supply – 94 items (99%), forest fire modules – 119 items (134% to the plan of the first quarter).

86. As of January 1, 2017 forest entities had 3121 radio stations, including 1399 portable ones, 878 mobile and 844 stationary ones. According to the minimum list the complete set for FFCS and UFPS requires 2282 radio stations. At the same time at the beginning of 2016 there were 2699 radio stations, where 939 - portable ones, 909 – mobile ones and 854 – stationary ones, which is also more than is required according to the minimum list of a complete set for FFCS and UFPS, 47,6% of radio stations needed repairing and servicing. At the same time in 2014 in forest entities there were 2920 radio stations: 940 portable, 1050 – mobile and 932 stationary ones, from which 1254 radio stations (43%) needed repairing and servicing. Thus, the means of communication have the considerable wear and require annual repair and service. The resource of radio stations, which are used in forestries for a long time, is worked out. Radio stations of the type used in the forestry enterprises aren't made any more therefore transition to new ones is simply inevitable. At the same time, there are issues (especially in 2015) of frequency, for operation in unison with the Ministry for Emergency Situations, the Ministry of Internal Affairs and other services with which the Ministry interacts in case of suppression of fires.

87. Now three forest entities are entrusted to work out opportunities of transition to new frequencies. Borovlyany Special Forestry Enterprise has already resolved this issue. Procurement of new radio stations with a frequency of 146-147 MHz is carried out. In this range the Ministry for Emergency Situations, the Ministry of Internal Affairs and frontier services work. At the same time it is financially difficult to deal with everything. The problem is not only in procurement of radio stations, but also installation, mounting, service is also expensive. Phased transition of all forest entities is planned to the new frequency – approximately within 5 years. At the same time in the forest area there shall be one stationary radio station, a mobile one – in the vehicle, that is 2 units for UFPS, and a set of portable radio stations – on average 8 items.

88. The great value in prevention and firefighting is given to the use of highly effective fireproof and fire extinguishing chemical compositions. Chemical structures are used for laying preventive long lasting fire-extinguishing strips in districts of the most probable emergence of fires: zones of resettlement and alienation of the Chernobyl NPP, along the systems of communications, and also in the most fire-dangerous forests; protecting strips just in front of the

edge of the fire, basic strips for fight with lower fires of strong intensity and upper fires, guarding of wildfires, and also for their suppression. Use of chemical mixtures allows protecting personnel of forest fire services from dangerous factors at fight against wildfires in the zones of radioactive contamination.

89. A complete set for FFCS and UFPS also includes fireproof and fire extinguishing mixtures of Metafosil and the new unified composition of Kompleksil. The industrial release of Metafosil has been made at the Gomel chemical plant since 1996. In March, 2016, 5 tons of the new unified mixture for elimination of forest and peat fires was produced. The developer is the Research institute of physical and chemical problems of the Belarusian State University. The planned volume of acquisition of Kompleksil by forestries in 2017 is 42,6 t.

90. At each FFCS the team is organized; the structure and staff are defined by the chief of FFCS or the engineer for forest protection, duties of members of the team are appointed, fire extinguishing means and transport are distributed and fixed. The forest warden from the officials of the state forest protection forms crews which, if necessary, independently extinguish wildfires.

91. In the organization of forest fire protection one of the major links is the fire-prevention arrangement of the territory of the forest fund including the whole complex of organizational and economic actions for the prevention of emergence and restriction of spread of fires, expeditious detection and elimination of the centers of ignition.

92. For optimization of fire-prevention arrangement of the forest territory the prognosticated time of delivery of forces and fire extinguishing means to the ignition center, standard demands to each initial place of basing of forest fire stations and services of elimination of fires, and also probability of emergence and development of the centers of large wildfires are considered.

93. The specifics of fire prevention in forests, first of all include actions for creation of a system of fire-prevention barriers in them (natural and artificial) limiting distribution of fires in the forest, and also the structure of a network of roads and reservoirs for ensuring expeditious elimination of the arising burning centers. Fire-prevention barriers are a natural component of landscape on the territory of the forest fund in the form of rivers and lakes, fire resistant sites of the forest. The artificial ones are as follows:

- mineralized strips,
- fire-prevention gaps,
- meliorative ports,
- fire resistant edges from plantations of deciduous breeds,
- gaps which are formed at the expense of railways and highways, power lines, etc.

94. Mineralized protecting strips are one of the most effective means of localization of wildfires. Localization of fires by means of protecting mineralized strips is effective at

suppression of slowly spreading weak local steady fires in windless weather when there is no opportunity to extinguish a flame on a fire edge by manual means or it doesn't yield positive results.

95. The protecting mineralized strips are also laid for localization of fires without preliminary stop of their spread by direct impact on the edge, more reliable localization of fires whose spread was suspended, and also prevention of renewal of a fire from the hidden centers of burning after its localization.

96. While laying the mineralized strips their width is defined in the mechanized mode by width of capture of the corresponding soil-cultivating tools and gears. Protecting strips, depending on look and intensity of the fire and the used tool, are laid unary or double.

97. Annually in the forest fund of the Ministry of Forestry about 70 thousand km of new mineralized strips and fire-prevention gaps are made, and more than 160 thousand km of mineralized strips and fire-prevention gaps are taken care of.

98. Now arrangement of the forest fund is carried out on the basis of the forest firefighting zoning developed by the Institute of Forest of the NAS of Belarus according to TCEP "Rules of firefighting arrangement of forests of the Republic of Belarus". The differentiated system of actions for fire-prevention arrangement of the forest fund was developed on the basis of forest fire division into districts and includes actions for creation in forests of a system of fire-prevention barriers in the form of barriers and gaps, protective mineralized strips, fire resistant plantations, and also the structure of network of forest roads and fire reservoirs.

99. The network of forest roads on the territory of the forest fund provides transport availability of the forest areas and timely expeditious delivery of forces and fire extinguishing means to places of fire in the determined standard time. Roads of fire-prevention appointment are arranged in addition to a network of roads of economic appointment for ensuring a trip of motor transport to fire reservoirs and fire-dangerous sites.

100. In the forest fund the network of fire reservoirs is created by the corresponding preparation of natural water sources and construction of special artificial reservoirs. For extinguishing entrances and special platforms for water intake with fire trucks and motor-pumps are arranged to natural reservoirs. At insufficient quantity of natural reservoirs in forests artificial fire reservoirs are arranged. The effective water-supply in fire reservoirs has to make not less than 100 m^3 with depth of 1,3 m during the hottest period of fire-dangerous seasons.

101. According to the TCEP, in the I forest fire belt, not less than 0,5 km, in the II – not less than 0,4 km, in the III – not less than 0,3 km of fire-prevention gaps on 1000 hectares of the forest fund are arranged. On the forest territory belonging to the I forest fire belt not less than 10

km, II – not less than 8 km, III – not less than 6 km of protective mineralized strips on 1000 hectares of the forest fund are created.

102. These forest fire belts are divided according to climatic, soil and hydrological, forest pyrologic, eco-economic, anthropogenous and other factors on the territory of Belarus. The regional complex indicator of potential danger of emergence and spread of wildfires including the following factors is the basis for forest firefighting zoning: class of natural fire danger of forests, long-term inflammability of forests, woodiness and population density of the region, distribution of the area of the forest fund for zones of radioactive pollution. Because these factors are rather changeable, it is necessary to carry out updating of forest firefighting zoning periodically.

103. The choice of ways and technical means for fire fighting depends on look and intensity of spread of a fire, presence of forces and fire extinguishing means, the planned policy strokes and technical ways of suppression, as well as on a meteorological situation.

104. The analysis of long-term (2002-2015) statistics on terms of suppression of fires in the forest fund of Belarus after their detection has shown that their main quantity (67,6%) is liquidated within an hour, 18,5% of fires – within 1-2 hours; 10,4% – within 2-6 hours; 2,4% – within 6-12 hours and only 1,1% – within 12 hours and more (tab. 12).

Tab. 12. Distribution of the number of wildfires according to suppression terms after detection in the forest fund of Belarus

Suppression term	Hours					
	0,5 and less	0,6-1,0	1,1-2,0	2,1-6,0	6,1-12,0	12,1 and more
Number of fires, %	42,4	25,2	18,5	10,4	2,4	1,1

105. However, in spite of the fact that forest prevention from fires is organized by the Ministry of Forestry at the high level, CY 2015 showed that there are difficulties, and not only in respect of hardware. In particular, in the southern border areas with Ukraine the complexity with suppression of natural fires was connected with the lack of the developed road network in the presence of large forests, as well as a large number of remote sites – swamps.

106. The plan of fire-prevention arrangement of the forest fund on territories (fig. 6), that border Ukraine, became the most global action. The project of fire-prevention arrangement developed by the Ministry of Forestry together with the State Border Committee provides construction of forest roads, their repair and service. At the same time the project has planned a number of actions – from preventive ones to those prior to the actions limiting distribution of wildfires (creation and clearing of fire-prevention gaps, taking care of them, the arrangement of fire-prevention barriers and

mineralized strips, splitting of quarter glades, arrangement of fire resistant edges, creation of reservoirs of fire-prevention appointment, entrances to them).

107. Fire-prevention arrangement of the border territory will be made in coordination with already existing and planned boundary arrangement of the Border of the Republic of Belarus. The created fire-prevention gaps will be transferred to the Border committee which will be responsible for their service.

108. According to the project, the total cost of fire-prevention arrangement of the forest fund of the boundary territory of the Border of the Republic of Belarus with Ukraine makes more than 100 billion rubles.

109. Within the project the State Boundary Committee planned to create in addition 257 more km of protection belts – ten-meter mineralized strip, the Ministry of Forestry – 82,3 km of fire-prevention gaps and 28,5 km of fire-prevention ditches. At the same time in CY 2016 80,2 km of new fire-prevention gaps and 795,4 km of mineralized strips were made, 68,9 km of fire-prevention gaps and 147,7 km of mineralized strips were taken care of. Besides, 104 local information boards, 96 barriers were established, 16 leisure areas were equipped, 18 systems of video surveillance were installed, also 4 fire and observation towers and fire and observation masts were constructed.

110. In 2017 this work will be continued, and construction of 7 fire and observation towers and fire and observation masts with systems of video surveillance, creation of 41,2 km of fire-prevention ditches is planned (18 km in SFE "Polessye Forestry" and 23,2 km in SFE "Stolin Forestry"), besides, grubbing of 22,1 km of fire-prevention gaps will be carried out.

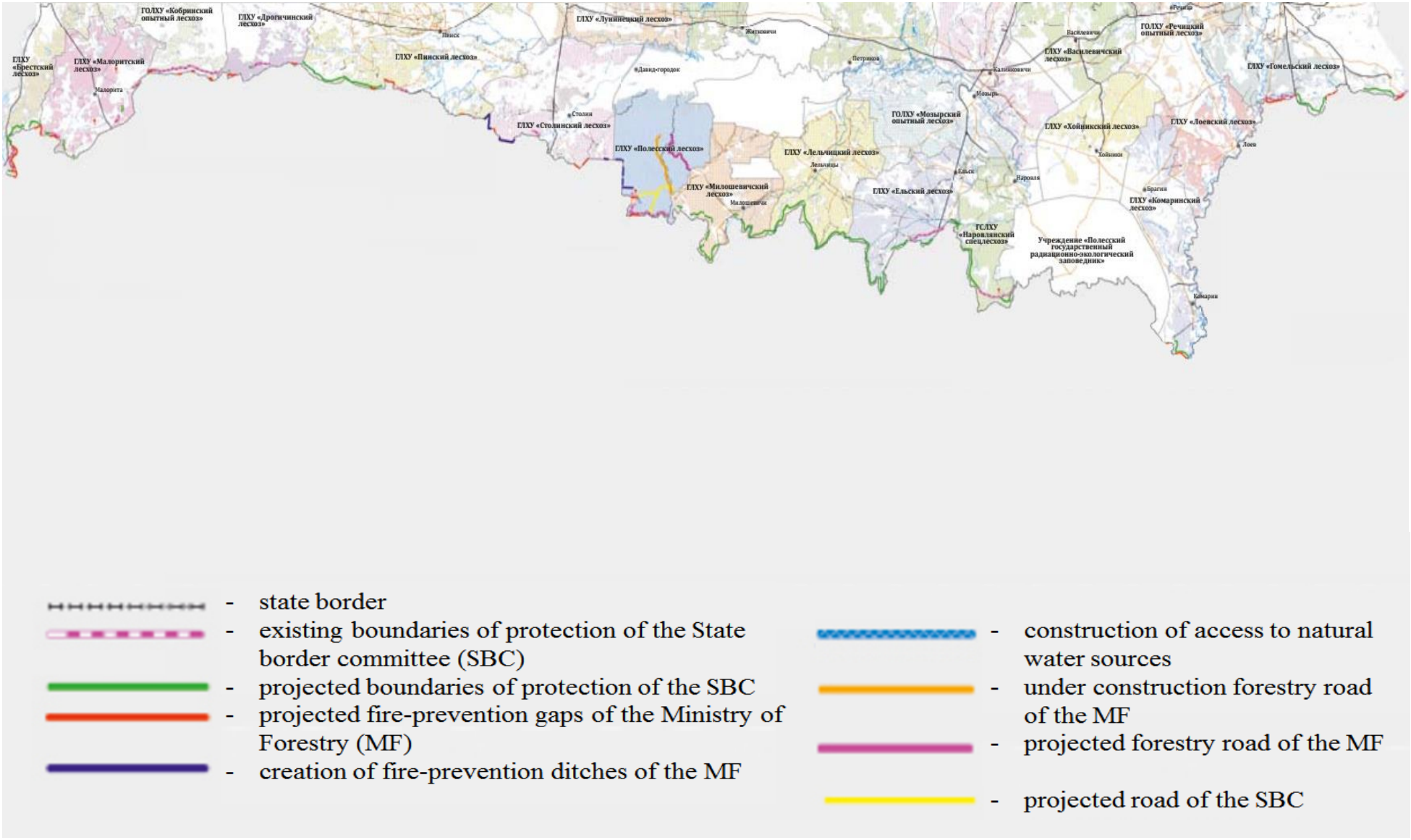


Fig. 6. Fire-prevention arrangement of the forest fund of the territory adjacent to the Border of the Republic of Belarus and Ukraine

111. Thus, the analysis of efficiency of means and methods of elimination of wildfires showed that now at various levels the operational solution to problems of elimination of the reasons which led to appreciable spread of fires including cross-border ones was made. On the territory of the forest fund for more effective prevention and elimination of fires improvement of the differentiated system of fire-prevention actions is necessary, which will allow providing ecological integrity of forest biogeocenoses and keeping their nature protection and environment forming functions on the territory of our state.

3. THE ANALYSIS OF THE DATA UPON THE LEVEL OF RADIOACTIVE CONTAMINATION OF THE TERRITORY OF THE REPUBLIC OF BELARUS, FOREST COVERAGE, POPULATION DENSITY OF REGIONS AND THE LEVEL OF FIRE INCIDENCE OF FORESTS WHICH BELONG TO THE LEGAL ENTITIES CONDUCTING FOREST MANAGEMENT

3.1 The analysis of forest coverage, population density of the regions and natural fire danger of forests of the forest fund of the legal entities conducting forest management

112. When updating forest firefighting zoning it is necessary to consider a complex of climatic, soil and hydrological, forest pyrologic, anthropogenous and other factors. For the purpose of definition of the complex regional indicator of potential fire danger of forests taking into account all legal entities conducting forestry we have made the analysis of the following factors: class of natural fire danger, woodiness of a zone of activity of a forestry, population density, gravity of radioactive pollution. These factors all together determine the need of carrying out on territories of forest entities the same types and volumes of fire-prevention actions. (tab. 13).

Tab. 13. Territory and population density of the Republic of Belarus

Administrative territory	Territory, km^2	Population, number of people	Number of people per 1 km^2
1	2	3	4
Brest region			
Brest	146,1	335645	2297
Baranovichi	85,0	17889	2106
Pinsky	47,4	137519	2904
Districts			
Baranovichi	2167,6	32479	15
Berezovsky	1412,8	64217	45
Brest	1544,1	40418	26
Gantsevichsky	1709,6	28480	17
Drogichinsky	1855,1	38357	21
Zhabinkovsky	684,2	24543	36
Ivanovsky	1551,4	40062	26
Ivatsevichsky	2998,1	55679	19
Kamenetsky	1687,1	36182	21
Kobrinsky	2039,8	85928	42
Luninetsky	2708,5	68610	25
Lyakhovichsky	1352,3	26695	20
Maloritsky	1373,6	24592	18
Pinsk	3255,9	47241	15

Pruzhansky	2825,9	48670	17
Stolin	3342,1	74725	22
Vitebsk region			
Vitebsk	124,5	366299	2942
Novopolotsk	48,5	102261	2108
Districts			
Beshenkovichsky	1249,7	16105	13
Braslavsky	2270,1	26706	12
Verkhnedvinsky	2140,8	22170	10
Vitebsk	2705,1	37487	14
Gluboksky	1759,6	38100	22
Gorodoksky	2980,1	23667	8
Dokshitsky	2267,6	24038	11
Dubrovensky	1249,7	14950	12
Lepelsky	1822,2	33419	18
Lioznensky	1417,6	15924	11
Miorsky	1786,6	21215	12
Orshansky	1707,7	158747	93
Polotsk	3178,6	108643	34
Postavsky	2096,4	36951	18
Rossonsky	1926,9	9797	5
Sennensky	1966,1	22604	11
Tolochinsky	1498,6	25702	17
Ushachsky	1489,4	13696	9
Chashniksky	1481,1	31811	21
Sharkovshchinsky	1189,2	15903	13
Shumilinsky	1695,4	18521	11
Gomel region			
Gomel	135,2	526871	3897
Districts			
Braginsky	1960,5	12430	6
Buda-Koshelevsky	1594,5	30964	19
Vetkovsky	1558,6	17812	11
Gomel	1955,9	67656	35
Dobrushsky	1452,7	37054	26
Elsky	1365,7	15877	12
Zhitkovichsky	2916,3	37035	13
Zhlobinsky	2110,8	102159	48
Kalinkovichsky	2756,2	60624	22
Kormyansky	949,2	13825	15
Lelchitsky	3221,3	24968	8
Loyevsky	1045,5	12535	12
Mazyr	1603,5	131812	82
Narovlyansky	1588,8	10693	7
Octyabrsky	1381,2	14347	10
Petrikovsky	2835,2	29109	10
Rechitsky	2714,0	99856	37
Rogachevsky	2067,0	58331	28
Svetlogorsk	1899,9	85492	45
Hoyniksky	2027,7	19890	10

Chechersky	1229,9	14624	12
Grodno region			
Grodno	142	361352	2545
Districts			
Berestovitsky	744,0	15950	21
Volkovyssky	1193,0	71271	60
Voronovsky	1418,0	26953	19
Grodno	2594,0	49830	19
Dyatlovsky	1544,0	25875	17
Zelvensky	870,0	16053	18
Ivyevsky	1845,0	24758	13
Korelichsky	1094,0	21025	19
Lidsky	1567,0	132291	84
Mostovsky	1342,0	29342	22
Novogrudsky	1668,0	46098	28
Ostrovetsky	1569,0	23826	15
Oshmyansky	1216,0	31190	26
Svislochsky	1449,0	16401	11
Slonim	1471,0	65371	44
Smorgonsky	1490,0	53113	36
Shchuchinsky	1911,0	41889	22
Minsk region			
Zhodino	23,2	63560	2740
Districts			
Berezinsky	1940,3	22937	12
Borisovsky	2988,0	183010	61
Vileysky	2453,8	48674	20
Volozhinsky	1916,8	34061	18
Dzerzhinsky	1189,5	63205	53
Kletsky	974,1	29022	30
Kopylsky	1607,7	29062	18
Krupsky	2138,7	23587	11
Logoysky	2356,0	35145	15
Lyubansky	1913,8	32478	17
Minsk	1902,7	188294	99
Molodechnensky	1392,2	136797	98
Myadelsky	1964,3	26890	14
Nesvizhsky	862,8	39287	46
Pukhovichky	2442,2	65984	27
Slutsky	1821,1	92379	51
Smolevichsky	1392,6	43866	31
Soligorsky	2498,9	134647	54
Starodorozhsky	1370,4	20109	15
Stolbtsovsky	1884,5	39917	21
Uzdensky	1181,0	23066	20
Chervensky	1630,4	31918	20
Mogilev region			
Mogilev	118,5	374655	3162
Bobruisk	90,0	218263	2425
Districts			

Belynichsky	1419,5	19574	14
Babruysky	1599,1	17582	11
Bykhovsky	2263,2	30970	14
Glussky	1335,4	14349	11
Gorecky	1284,3	45764	38
Dribinsky	766,5	10480	14
Kirovsky	1295,2	20012	15
Klimovichsky	1542,8	25661	17
Klichevsky	1800,3	15395	9
Kostyukovichsky	1493,8	23989	16
Krasnopolsky	1223,0	9969	8
Krichevsky	777,5	32896	42
Kruglyansky	881,8	14386	16
Mogilev	1895,4	40181	21
Mstislavsky	1332,5	22098	17
Osipovichsky	1947,2	48719	25
Slavgorodsky	1317,8	13388	10
Hotimsky	858,9	11338	13
Chaussky	1471,4	18936	13
Cherikovsky	1020,2	13767	13
Shklovsky	1333,2	28323	21

113. Degree of the forest coverage is determined with the help of the indicator of woodiness, that is the relation of the area covered with forests to the total area, and is expressed as percentage.

114. Woodiness of the territory is one of key indicators, characterizing the forest fund of the country. Woodiness value in different areas of the Republic can differ depending on physiographic, climatic and soil conditions.

115. According to the data of the State forest inventory as of January 01, 2015, in Belarus the tendency to growth of woodiness which in 2015 reached 39,5% (0,4% more, than in 2013 and 1,7% more, than in 2001) remains (fig. 7).

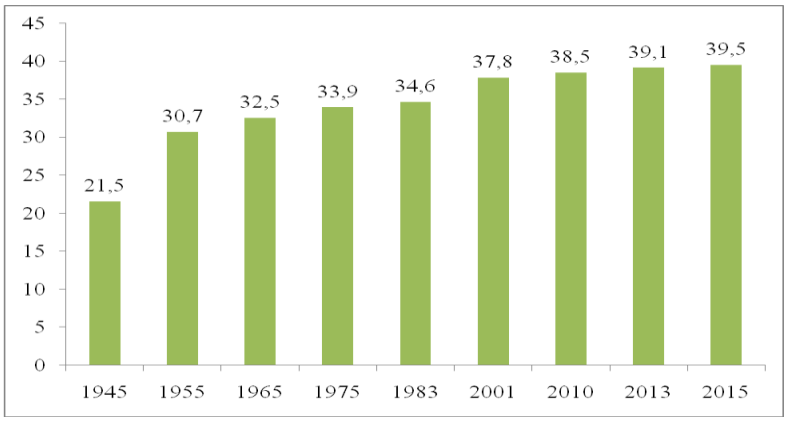


Fig. 7. Dynamics of woodiness of the territory of Belarus, % (1945-2015)

116. It has been found out that the greatest percent of woodiness is characteristic of Gomel region – 46,6%, then comes Vitebsk – 42,5%, Brest – 40,5%, Mogilev – 39,1%, Minsk – 38,3% and Grodno region – 37,0% (fig. 8).

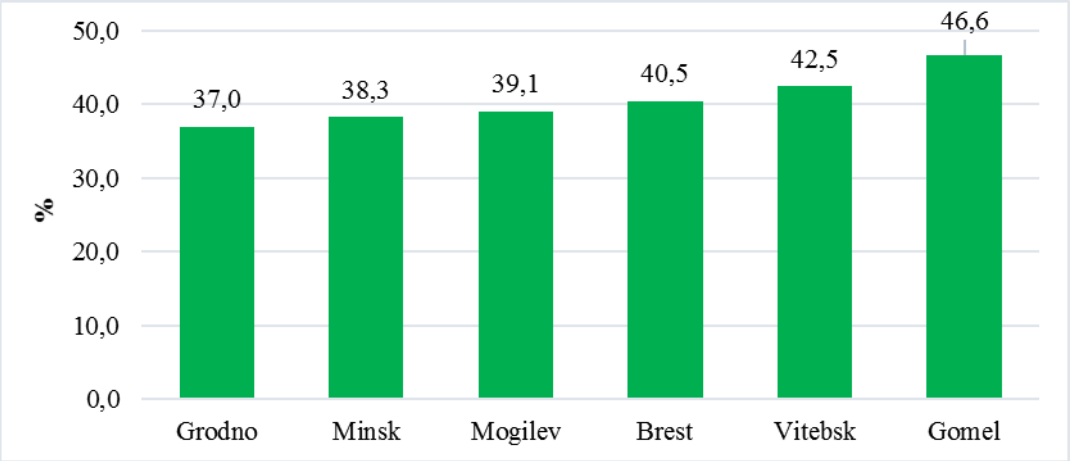


Fig. 8. Woodiness of the territory in SFPA

117. Among areas the greatest percent of woodiness is in Lelchitsky (69%) and Rossonsky (68%) districts. The smallest indicator of woodiness is noted in Kopylsky district of Minsk region (17,8%) and in Goretsky district of Mogilev region (23,1%).

118. It should be noted that for the last decade 70,7% of wildfires of their general quantity happen because of the population. Population density of Belarus makes 45,8 person/ sq.km. The greatest population density is noted in Minsk region – 84,9 person/ sq.km, the smallest one – in Vitebsk region (29,8 person/sq.km) (fig. 9). The smallest density is observed in Rossonsky district of Vitebsk region (8,0 person/ sq.km), Braginsky (6,7 person/ sq.km) and Narovlyansky (7,0 person/ sq.km) districts of Gomel region. The highest density – in Molodechnensky (98,0 person/ sq.km) and Minsk (90,8 person/ sq.km) districts of Minsk region (tab. 14).

Tab. 14. The database on the level of radioactive pollution of the territory of the forest fund of the Republic, woodiness and population density of regions, natural fire danger of forests

Organization	Woodiness, %	Population density, pers./km^2	Class of natural fire hazard, point[1]	Gravity of radioactive polution[2]
1	2	3	4	5
Brest SFPA:				
Baranovichsky forest entity	29,0	92,5	20	0

Brest forest entity	37,0	121,5	30	0
Gantsevichsky forest entity	63,0	17,0	20	0
Drogichinsky forest entity	59,8	21,0	20	0
Ivatsevichsky forest entity	41,9	32,0	20	0
Kobrinsky experimental forest entity	25,4	39,5	20	0
Luninetsky forest entity	44,7	25,0	10	2
Lyakhovichsky forest entity	38,0	20,0	10	0
Maloritsky forest entity	45,7	18,0	20	0
Pinsky forest entity	29,0	20,5	20	1
Polesia forest entity	32,5	22,0	0	2
Pruzhansky forest entity	45,0	17,0	30	0
Stolinsky forest entity	34,0	22,0	20	3
Telekhansky forest entity	40,2	17,0	20	0
Vitebsk SFPA:				
Begomlsky forest entity	41,6	11,0	30	0
Beshenkovichsky forest entity	28,0	13,0	20	0
Bogushevsky forest entity	38,0	11,0	20	0
Verkhnedvinsky forest entity	41,0	10,0	10	0
Vitebsk forest entity	41,0	142,7	10	0
Gluboksky experimental forest entity	25,9	22,0	20	0
Gorodoksky forest entity	55,3	8,0	10	0
Disnensky forest entity	24,3	12,0	10	0
Dretunsky forest entity	59,8	34,0	10	0
Lepelsky forest entity	-	20,0	20	0
Lioznensky forest entity	55,5	11,0	10	0
Orshansky forest entity	23,7	52,5	20	0
Polotsk forest entity	55,6	65,3	10	0
Postavsky forest entity	38,0	15,5	10	0
Rossonsky forest entity	68,0	8,0	10	0
Surazhsky forest entity	43,0	14,0	10	0
Tolochinsky forest entity	36,0	17,0	20	1
Ushachsky forest entity	46,5	9,0	20	0
Shumilinsky forest entity	35,5	11,0	10	0
Gomel SFPA:				
Buda-Koshelevsky experimental forest entity	23,0	19,0	20	4
Vasilevichsky forest entity	48,0	30,0	10	2
Vetkovsky specialized forest entity	42,8	11,0	20	6
Elsky forest entity	53,3	12,0	10	5
Gomel forest entity	38,0	284,3	20	3
Zhitkovichsky forest entity	54,5	13,0	10	1
Zhlobinsky forest entity	32,0	48,0	20	2
Kalinkovichsky forest entity	48,5	22,0	20	2
Komarinsky forest entity	34,0	6,0	20	4
Lelchitsky forest entity	69,0	8,0	20	3
Loyevsky forest entity	35,4	12,0	20	2

Miloshevichsky forest entity	60,0	8,0	10	3
Mazyrsky experimental forest entity	56,0	82,0	20	2
Narovlyansky specialized forest entity	49,0	7,0	20	
Octobersky forest entity	57,2	10,0	20	0
Petrikovsky forest entity	53,0	10,0	10	0
Rechitsky experimental forest entity	43,6	37,0	10	2
Rogachevsky forest entity	32,7	28,0	20	3
Svetlogorsky forest entity	54,0	45,0	20	1
Hoyniksky forest entity	45,7	8,0	10	3
Chechersky specialized forest entity	48,0	14,0	10	6
Grodno SFPA:				
Volkovyssky forest entity	28,1	35,0	30	0
Grodno forest entity	39,0	150,3	30	0
Dyatlovsky forest entity	44,0	50,0	30	1
Ivyevsky forest entity	42,0	13,0	10	2
Lidsky forest entity	29,1	52,0	30	0
Novogrudsky forest entity	34,2	24,0	20	1
Ostrovetsky forest entity	48,0	15,0	30	0
Skidelsky forest entity	38,3	86,1	30	0
Slonimsky forest entity	36,0	31,0	20	0
Smorgonsky experimental forest entity	88,0	31,0	20	0
Shchuchinsky forest entity	32,0	22,0	20	0
Minsk SFPA:				
Berezinsky forest entity	51,0	12,0	20	2
Borisovsky experimental forest entity	50,2	61,0	30	1
Borovlyansky specialized forest entity	–	–	–	0
Vileysky experimental forest entity	40,4	20,0	30	1
Volozhinsky forest entity	36,9	18,0	30	1
Kletsky forest entity	22,5	38,0	20	0
Kopylsky experimental forest entity	17,8	18,0	20	0
Krupsky forest entity	48,0	11,0	20	1
Logoysky forest entity	52,0	15,0	20	0
Lyubansky forest entity	37,0	17,0	20	1
Minsk forest entity	27,0	954,0	20	0
Molodechnensky forest entity	34,0	98,0	20	1
Pukhovichsky forest entity	43,0	27,0	10	0
Slutsky forest entity	21,6	27,6	20	1
Smolevichsky forest entity	35,0	31,0	20	0
Starobinsky forest entity	35,7	54,0	20	1
Starodorozhsky experimental	50,5	15,0	30	0

forest entity				
Stolbtsovsky forest entity	45,6	21,0	20	0
Uzdensky forest entity	39,7	20,0	20	0
Chervensky forest entity	40,7	20,0	20	0
Mogilev SFPA:				
Belynichsky forest entity	41,0	15,0	10	2
Babruysky forest entity	38,0	139,6	10	1
Bykhovsky forest entity	43,7	14,0	20	4
Glussky forest entity	25,1	11,0	20	0
Goretsky forest entity	22,1	22,3	10	1
Klimovichsky forest entity	38,0	17,0	10	2
Klichevsky forest entity	55,8	9,0	10	2
Kostyukovichsky forest entity	33,7	15,0	20	3
Krasnopolsky forest entity	62,4	9,0	20	6
Mogilev forest entity	25,1	206,5	20	2
Osipovichsky experimental forest entity	54,0	25,0	10	0
Chaussky forest entity	31,9	17,0	20	3
Cherikovsky forest entity	38,0	22,0	10	6
Forest entities of the Ministry of Defence:				
Krupsky military forest entity	43,0	11,0	20	0
Ivatsevichsky military forest entity	31,0	19,0	10	0
Forest entities of the Ministry of Education:				
Negorelsky educationally experimental forest entity	–	53,0	20	0
Polotsk educationally experimental forest entity	–	–	10	0
Experimental Forest Bases of the Institute of Forest of the NAS of Belarus:				
Dwinskaya EFB	–	22,0	10	0
Korenevskaya EFB	50,6	35,0	20	0
Zhornovskaya EFB	68	25,0	10	0
Minsk City Administration:				
State Unitary Enterprise "The Minsk Forest-Park Economy"	–	–	20	0
Nature Protection Institutions of the Administration of the President of the Republic of Belarus:				
NP "Pripyatsky"	53,0	10,0	10	0
SUE "Berezinsky Biosphere Reserve”	50,0	29,0	0	0
NP "Narochansky"	41,0	17,0	10	0
NP "Belovezhskaya pushcha"	24,1	16,0	20	0
NP "Braslau Lakes"	46,8	12,0	20	0
SFI "Teterinskoye"	26,0	16,0	10	0
SFI "Krasnoselskoye"	–	99,0	10	0
Department on Mitigation of Consequences of the Accident at the Chernobyl NPP:				
Polesye State Radiation-Ecological Reserve	56,0	-	20	–

Note: [1.]Class of natural fire danger: < -30; 2,0-2,9 – 20; 3,0-3,9 – 10; 4,0 and > – 0 points. [2.] Gravity of radioactive pollution: Ct 500 and more – 6; Ct 250-500 – 5; Ct 100-250 – 4; Ct 25-100 – 3; Ct 1-25 – 2; Ct less 1 – 0.

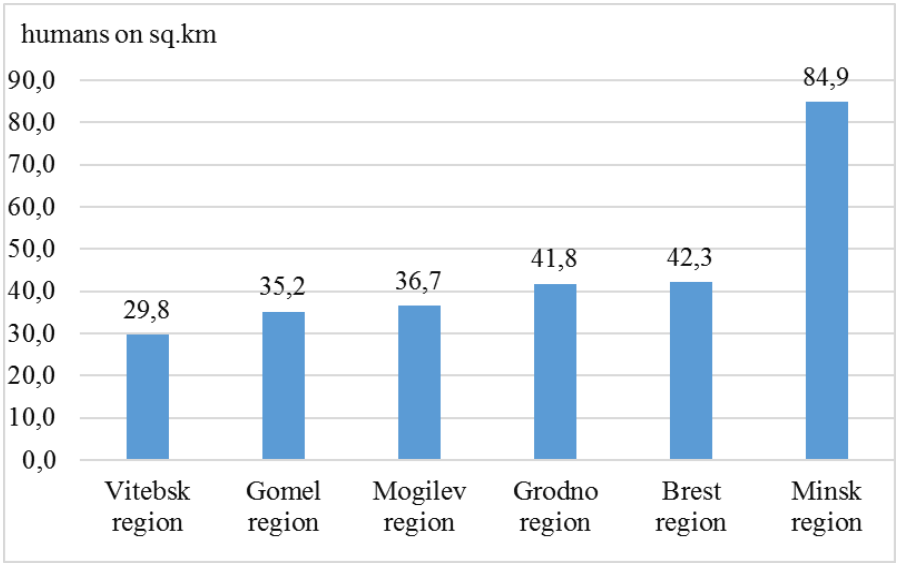


Fig. 9. Population density in regions of the Republic

119. Fire danger of the forest areas is determined by their pyrological characteristic on the basis of which the class of natural fire danger depending on age, structural and typological indicators of forest plantations is defined.

120. Natural fire hazard of the forest fund is in direct dependence on certain types and groups of types of the forest which determine quantitative and qualitative composition of forest combustible materials, and completeness and location of forest plantations characterize conditions of maturing of combustible materials and their subsequent intensity of burning.

121. The type of the forest causes both formation of the main conductors of burning, and necessary weather conditions for emergence of wildfire on the concrete site. As a basis for definition of a degree of fire danger of the forest fund of the Republic the scale of the academician I. S. Melekhov modified for climatic conditions of Belarus by I. E. Richter where all types of the forest and the forest areas whenever possible, time of emergence and a type of the fire are distributed to 5 classes of natural fire danger: I – very high, II – high, III – average, IV – low and V – very low.

122. The scale of assessment of types of the forest and the forest areas in accordance with the degree of natural fire danger allows predicting the most probable types of fires, conditions and duration of the period of their possible emergence and distribution (tab. 15).

Tab. 15. Scale of assessment of types of the forest and the forest area in accordance with the degree of natural fire danger for conditions of Belarus (according to I. S. Melekhov)

Class of natural fire danger	Object of fire (characteristic types of the forest and fellings, other categories of plantations and the areas uncovered with forest)
I – very high	Coniferous young growths of all types of the forest. Lichen, heather pine forests. Reclaimed ledum pine forests, sphagnum and sedge ones. Continuous fellings from under lichen, heather, cowberry, mossy, bilberry, shamrock pine forests. Strongly damaged plantations (sites of windbreak, windfall, intensive selective fellings which are cluttered up with burnings) of all types of the forest.
II – high	Cowberry and mossy pine forests with pine subgrowth or dense cade underbrush.
III – average	Cowberry, mossy, adder-spit, shamrock pine forests. Cowberry, adder-spit, mossy and shamrock spruce groves. Alder thickets and spruce forests on the drained peat bogs.
IV – low	Ferny, glague, bilberry and nettle spruce groves. Politryc, sedge, sedge-bog-moss, bog-moss, ledum pine forests. Pine forests and plantations of deciduous breeds of grass, pre-stream-grass and sedge and grass types of the forest. Oak groves, ash forest, maple forest, linden forest, fungi of all types. Birch forests, aspen forests, alder forest of all types, except politric one. The continuous fellings (cluttered up) of glague and other types of the forest in crude and wet places.
V – very low	Politryc, pre-stream-grassy, sedge, sedge-bog-mossy, bog-mossy spruce groves. Birch forests, aspen forests, bog-mossy grey alder forests, black alder forests of all types.
Note – Fire danger is one class higher: a) for the timberland adjoining public roads or located in close proximity to the fire dangerous forest enterprises; b) for small sites of the forest on the waterless valleys surrounded with the areas with the increased inflammability.	

123. Distribution of the area of the forests on classes of natural fire danger is presented in figure 10 from which it follows that practically all forests on the territory of Belarus are very fire-dangerous (the middle class of natural fire danger makes 2,7).

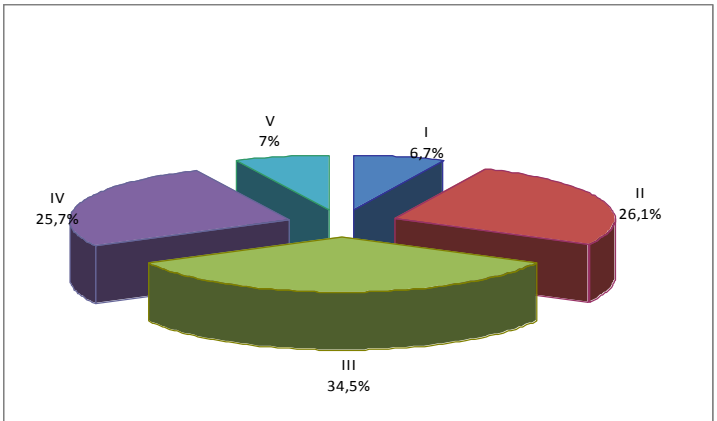


Fig. 10. Distribution of the area of plantations of the forest fund of the Republic of Belarus on classes of natural fire danger

124. In the context of the State Forestry Production Associations (SFPA) of the Republic of Belarus the forest plantations of Grodno SFPA have the middle class of natural fire danger of 1,9

and are the most fire dangerous, the least dangerous – the forests of Vitebsk SFPA with the middle class of natural fire danger of 3,1 (fig. 11).

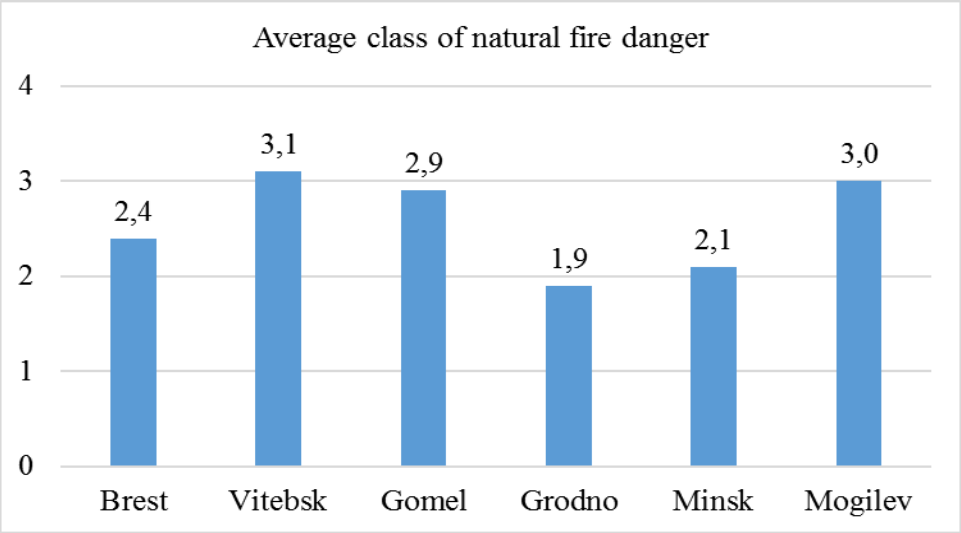


Fig. 11. Distribution of the area of plantations of the forest fund on classes of natural fire danger in SFPA

3.2 Assessment of the radioactive contamination of the territory of the forest fund of the Republic of Belarus

125. As a result of the Chernobyl accident on April 26, 1986 (Ukraine) emission of radioactive materials in the environment, including isotopes of uranium, plutonium, iodine-131 (a half-life period – 8 days), cesium-134 (a half-life period – 2 years), cesium-137 (a half-life period – 30 years), strontium-90 (a half-life period – 28, 8 years), etc. took place. Practically all administrative territories of Belarus, 17 regions of Russian Federation, 14 regions in Ukraine underwent radioactive contamination. About 35% of the Chernobyl emission of cesium-137 was the share of the territory of the Republic of Belarus. The Chernobyl emission reached the territory of Austria, Germany, Italy, Poland, Sweden, Slovenia, Greece, Norway and other European states.

126. The Chernobyl NPP is about ten kilometers far from the borders of the Republic of Belarus, which predetermined extremely high pollution of the southern parts of the state by radioactive elements of emission from the nuclear reactor. Features of weather conditions during the initial period after the accident, the structure and dynamics of emergency emission of radioactive materials caused difficult, very uneven nature of pollution of the territory of the Republic. Soon after the Chernobyl accident the Exclusion zone, the so-called “Chernobyl area

of alienation" which in 1986-1987 was called a "30-kilometer zone" – the territory forbidden for free access was set.

127. In the near zone of the Chernobyl NPP including a 30-kilometer zone around the station, levels of pollution of the territory by cesium-137 were extremely high and on certain sites exceeded 37000 kBq/sq.m. Even after the thirty-year-old period after the accident they make more than 14800 kBq/sq.m (400 Ki/sq.km). The most polluted ones turned out the northeast part of Gomel and the southeast part of Mogilev regions. It is significantly lower than the levels of radioactive pollution of the territory in the southwest part of Gomel region, the central parts of Brest, Grodno and Minsk (table 16).

Tab. 16. Pollution of the territory of the Republic of Belarus by cesium-137 (as of January 01, 2015)

Region	Including those with the level of pollution of the territory, thous. km^2			
	1–5 Cu/km^2	5–15 Cu/km^2	15–40 Cu/km^2	40 and > Cu/km^2
Brest	1,9	0,04	–	–
Gomel	11,53	4,63	0,92	0,32
Grodno	0,46	–	–	–
Minsk	0,61	0,01	–	–
Mogilev	5,10	1,85	0,53	–
Total	**19,6**	**6,52**	**1,45**	**0,32**

128. Now 19 areas of Gomel region, 13 districts of Mogilev region, 4 districts of Brest region, 10 areas of Minsk region and 3 districts of Grodno region belong to the territory of radioactive pollution.

129. Depending on density of pollution of soils by radionuclides and/or an average annual dose of radiation of the population the following zones of radioactive pollution are differentiated:

- a zone of evacuation (alienation) – the territory around the Chernobyl NPP from where in 1986 the population was evacuated (a 30-kilometer zone and the territory with which additional resettlement of the population (^{90}Sr – 3 Cu/sq.km was carried out; ^{238}Pu, ^{239}Pu, ^{240}Pu – > 0,1 Cu/sq.km was done).

- a zone of prime resettlement – the territory with a density of pollution of soils with ^{137}Cs radionuclides – 40 Cu/sq.km, either ^{90}Sr, or ^{238}Pu, ^{239}Pu, ^{240}Pu – 3,01 Cu/sq.km and >).

- a zone of the subsequent resettlement – the territory with a density of pollution of soils with 137Cs radionuclides from 15 to 40 Cu/km, or ^{90}Sr from 2 to 3 Cu/sq.km, or ^{238}Pu, ^{239}Pu, ^{240}Pu from 0,05 to 0,1 Cu/sq.km.

- a zone with the right for resettlement – the territory with a density of pollution of soils with radionuclides ^{137}Cs from 5 to 15 Cu/km, or ^{90}Sr from 0,5 to 2 Cu/sq.km, or ^{238}Pu, ^{239}Pu, ^{240}Pu from 0,02 to 0,05 Cu/sq.km.

- an accommodation zone with periodic radiation control – the territory with a density of pollution of soils with ^{137}Cs radionuclides from 1 to 5 Cu/km, or ^{90}Sr from 0,15 to 0,5 Cu/sq.km, or ^{238}Pu, ^{239}Pu, ^{240}Pu from 0,01 to 0,02 Cu/sq.km.

130. In relation to the general territory of the Republic, as of 1/1/2016, the areas of pollution with cesium-137 in zones made the following: an accommodation zone with periodic radiation control – 9,4%, a zone with the right for resettlement – 3,1%, a zone of the subsequent resettlement – 0,7%, a zone of prime resettlement – 0,2%.

131. Exclusion zones and resettlements on the territory of Belarus have the area of 6,7 thousand sq.km. The Belarusian sector of the zone of evacuation (alienation) of the Chernobyl NPP represents the compact territory of 1,7 thousand sq.km. The population living there was evacuated in 1986. Then lands on this territory were brought out of economic use. On July 18, 1988 the Polesye State Radiation-Ecological Reserve on the territory of three most affected from the accident areas of Gomel region – Braginsky, Narovlyansky and Hoyniksky ones - was created. The "Polesye State Radiation-Ecological Reserve" institution was transformed by the Decree of the President of the Republic of Belarus as of January 21, 2013 No. 41 to the public nature protection research institution "Polesye State Radiation-Ecological Reserve".

132. The exclusion zone represents the territory adjoining the Chernobyl NPP, which is the most polluted with radionuclides, compactly located (Braginsky's part, Hoyniksky and Narovlyansky districts of Gomel region), the zone of resettlement is dispersed on the territory of 4,5 thousand sq.km in 15 districts of two areas of the Republic, which creates certain difficulties according to its maintaining.

133. Unlike the exclusion zone, on the territory of the zone of resettlement strictly limited economic activity connected with maintenance in proper condition of roads, power lines and other objects having infrastructure value is conducted.

134. In the zone of prime resettlement economic activity is carried out with observance of health regulations and standards of radiation safety taking into account the technologies and methods aimed at providing production and goods, the content of radionuclides in which does not exceed republican admissible levels.

135. The particular legal regime functions on territories of zones of evacuation (alienation) and resettlement for the purpose of prevention of unauthorized penetration of citizens and vehicles, uncontrollable export of freights, suppression of the facts of poaching, collecting

"forest gifts". The main approaches to the maintenance of these zones were formulated in "The concept of maintenance of exclusion zones and resettlement".

136. For implementation of management of exclusion zones and resettlement, the organization and control of the condition of their protection and maintenance according to the law, the Government Resolution as of June 8, 1992 No. 343 created a special body – the Administration of exclusion zones and resettlement whose representatives work in 15 polluted districts of Gomel and Mogilev regions. Activity in the sphere of functioning of territories of radioactive pollution is regulated by the Department on mitigation of consequences of the accident at the Chernobyl NPP of the Ministry for Emergency Situations of the Republic of Belarus. While overcoming consequences of the Chernobyl accident in the Republic of Belarus a number of documents determining both the general strategy for this or that post-Chernobyl stage, and the separate directions of this activity were worked out.

137. According to the Law "Of the legal regime of the territories which underwent radioactive pollution as a result of the accident at the Chernobyl NPP" in the zone of alienation only economic activity connected with ensuring radiation safety, prevention of transfer of radioactive materials, performance of nature protection actions, and also research and experimental works are allowed. Unlike the exclusion zone, on the territory of the zone of resettlement strictly limited economic activity connected with maintenance of appropriate road condition, power lines and other objects having infrastructural value is conducted.

138. Regulation of control of radioactive pollution on the territory of the country is carried out according to the following normative documents:

- The law of the Republic of Belarus as of January 5, 1998 No. 122-Z "Of radiation safety of the population";

- The law of the Republic of Belarus as of May 26, 2012 No. 385-3 "Of the legal regime of the territories which underwent radioactive pollution as a result of the accident at the Chernobyl NPP";

- The order of the Ministry for Emergency Situations of the Republic of Belarus as of October 27, 2016 No. 255 "Of licensing the activities in the field of industrial safety, use of atomic energy and sources of ionizing radiation, the activity connected with control of radioactive pollution, activities for ensuring fire safety";

- The resolution of the Ministry for Emergency Situations of the Republic of Belarus as of June 5, 2008 No. 49 "Of the approval of the Instruction for order of organization and control of works on creation and use of the improved forage lands for the cattle which are in private use of citizens on territories of radioactive pollution";

- TCEP 144-2008 (02300) "Organization and work for deactivation of territories, objects and equipment". The Ministry for Emergency Situations of the Republic of Belarus, Minsk, 2008;

- TCEP 113-2007 (02300) "Order of inspection of territories, objects and equipment for carrying out decontamination works". The Ministry for Emergency Situations of the Republic of Belarus, Minsk, 2007;

- MM.MN 4194-2011 "The technique of performance of measurements while carrying out the radiation control exercised at preparation and realization of scrap metal, cutting of vehicles (equipment) for scrap metal";

- Notification No. 1 about the Amendment to MM-4194 "The technique of performance of measurements while carrying out the radiation control exercised at preparation and realization of scrap metal, cutting of vehicles (equipment) for scrap metal";

- The Resolution of the Council of Ministers of the Republic of Belarus as of November 21, 2007 No. 1584 "Of the approval of the list of the administrative procedures which are carried out by the Ministry for Emergency Situations concerning legal entities and individual entrepreneurs"

- The technique of performance of measurements of specific (volumic) activity of cesium-137 and effective specific activity of natural radionuclides of radium-226, thorium-232, potassium-40 on gamma spectrometers like "Progress", approved by the Department on elimination of consequences of the accident at the Chernobyl NPP of the Ministry of Emergency Situations on 12/20/2013;

- Control levels of radioactive pollution for making a decision on carrying out decontamination works, approved by the Committee on problems of consequences of the accident at the Chernobyl NPP at the Council of Ministers of the Republic of Belarus on 8/2/2004;

- Control level of soil pollution with cesium-137 for recultivation of the deactivated territories approved by the Committee on problems of consequences of the accident at the Chernobyl NPP at the Council of Ministers of the Republic of Belarus on 8/2/2004.

139. Security and regime actions are provided with carrying out autopatrol, functioning of the system of check-points.

140. The forests (20% of the total area of the forest fund of the Republic) underwent considerable pollution. Now the territory of the forest fund in the zones of radioactive pollution makes 1,67 million hectares or 17,6% of the total area of the forest fund of the Republic. The main share of the forests polluted by radionuclides is under authority of the Ministry of Forestry of the Republic of Belarus (83,4%) and the Department on elimination of consequences of the

accident at the Chernobyl NPP of the Ministry of Emergency Situations (12, 9%). 0,83 million hectares or 45% of the area of the polluted forests are the share of the forests of Gomel region and Mogilev region has 0,41 million hectares (34%).

141. Due to the fact that in the forest ecosystem cesium constantly recirculates without being brought out of it, levels of pollution of forest products, such as mushrooms, berries and game, remain dangerous. Determination of the density of soil pollution with radionuclides in forest quarters has allowed allocating them in zones of radioactive pollution (the legislation of the Republic of Belarus on the legal regime of the territories which underwent radioactive pollution as a result of the accident at the Chernobyl NPP). The radiation situation on the territory of the forest fund is being constantly updated. Radiation examination of forest quarters is annually conducted if it is found out that in connection with radioactive decay of cesium-137 there was a change of density of pollution to values at which a forest quarter must belong to another zone of radioactive pollution.

142. The Institute of Forest of the NAS of Belarus has defined methodical bases of social, ecological and economic assessment of functioning of forest entities on the territory polluted with radionuclides; the technique of determination of the economic damage caused to forestry as a result of the Chernobyl accident is improved.

143. With participation of the Institute the scientifically based system of forest exploitation on the territories polluted with radionuclides was developed, practically all normative documents regulating economic activity in the forests of Belarus polluted by radionuclides were prepared, including:

- "Temporary recommendations on forest management in the conditions of radioactive pollution" (1988);

- "Recommendations on technologies of reforestation of the territory of the Russian Soviet Federative Socialistic Republic, the Ukrainian SSR, the Belarusian SSR with a density of radioactive pollution with cesium-137 of 80 Cu/sq.km and higher" (1989);

- "The temporary instruction for inspection of the forests polluted with radionuclides as a result of the accident at the Chernobyl NPP" (1991);

- "Instruction on the organization and conducting radiation monitoring of the forest" (1993);

- "Guide to forest management in zones of radioactive pollution" (1995);

- "Strategic development plan for forestry in Belarus. Section "Forest Management on the Lands Polluted with Radionuclides" (1997);

- "Instruction for carrying out inspection of sites of preparation of production of forestry or raw materials, selection and preparation of tests for control of radioactive pollution" (1998);

- "Instruction for distribution of forest quarters to zones of radioactive pollution" (2001);

- "Recommendations on optimization of forest exploitation taking into account features of radioactive pollution of wood in various types of forest vegetative conditions" (2007);

- "Recommendations on rehabilitation of radioactively polluted forests on the basis of formation of mixed plantations of a certain species structure" (2010);

- "Republican admissible levels of content of cesium-137 in wood and other non-wood products of the forest";

- "Rules of forest management in zones of radioactive pollution".

144. Fight against wildfires is one of the main problems of maintenance of zones of exclusion and resettlement. For this purpose the following actions are carried out: the mechanized mineralized care of fire-prevention ruptures of various widths, fire-prevention strips on quarter glades, along roads, around former settlements, cemeteries, and also behind a perimeter strip, the maintenance of fire-prevention reservoirs, clearing of roads of fire-prevention and forestry value, quarter glades, flooding of a part of peat bogs.

145. Besides, preventive actions include carrying out land- and aviapatrol. Aviation patrol, in particular in Polesye State Radiation-Ecological Reserve is serviced in compliance with the signed contract, by means provided in the republican budget on the maintenance of this institution (The resolution of the Council of Ministers of the Republic of Belarus as of October 20, 2009 No. 1366 "On amendment of the resolution of the Council of Ministers of the Republic of Belarus as of March 16, 2006 No. 362").

146. The area of the PSRER forest fund makes 216,1 thousand hectares where 119,7 thousand hectares are covered with the forest. The biggest part of its territory is concentrated in the zone over 40 Cu/sq.km. The complex of the forestry, security and regime, fire-prevention and forest shelter actions which are carried out by the department of forestry and protection of the reserve is directed at the prevention of transfer of radionuclides out of the boundaries of the contaminated zones.

147. For firefighting, prevention gaps of 12, 20, 40 m wide with a general extent of 406 km, 952 km of mineralized strips on quarter glades, along roads, around former settlements, cemeteries and a strip of perimeter, 96 artificial fire reservoirs are established. For timely detection of centers of ignition 37 observation towers are put up.

148. In the PSRER for the last decade there were 35 fires on the total area of 10222,9 hectares (tab. 17). It was extremely fire-dangerous CY 2015 when there was the greatest share of the number of emergence (14 pieces) for this period, and the area passed by fires made 10159 hectares. On the territory of PSRER covered with the forest the greatest specific quantity of local

fires made 4999 hectares. The area of the upper fires made 2367 hectares while soil fires for this period were not noted. At the same time in 2006 fires were not registered.

Tab. 17. Dynamics of the area of wildfires according to types of territories of PSRER

Year	Number of fires, cases	Total area of fires, Ha.	Forest area, undergone by fires, ha				Non-forest area, undergone by fires, ha
			Total	including			
				Creeping fires	Crown fires	Peat fires	
2006	–	–	–	–	–	–	–
2007	2	1,8	0,6	0,6	–	–	1,15
2008	1	0,1	0,1	0,1	–	–	–
2009	1	0,6	0,6	0,6	–	–	–
2010	5	23,4	–	–	–	–	23,4
2011	3	10,9	10,9	10,9	–	–	0,01
2012	4	12,9	–	–	–	–	12,9
2013	2	5,5	5,5	5,5	–	–	–
2014	3	8,7	8,7	8,7	–	–	–
2015	14	10159	7366	4999	2367		2793
Total	**35**	**10222,9**	**7392,4**	**5025,4**	**2367**	**–**	**2830,46**

149. In the forest fund of the PSRER coniferous plantations of 52896 hectares (tab. 18) prevail. They are especially fire-hazardous, and become object for diseases and injurious organisms as there are no intermediate fellings. Carrying out partial fellings of intermediate use is possible for 44% of the areas where this species grows. However, the greatest territory polluted with cesium-137 with a density of 40 and more Cu/sq.km is occupied by soft-wooded broadleaved species that are less fire-hazardous.

Tab. 18. Radiation contamination of the forests of PSRER with cesium-137

Contamination density	Total, ha	Including, ha		
		coniferous	hard-wooded broadleaved species	soft-wooded broadleaved species
From 15 to 40 Cu/km^2	44523	23770	3729	17024
40 and more Cu/km^2	67018	29126	3788	34104
Total	**111541**	**52896**	**7517**	**51128**

150. In radioactively contaminated forests owing to restriction or termination of economic activity there is an active process of accumulation of combustible materials, which even more increases fire danger of these forests and demands for carrying out a specific system of actions for their protection.

151. Wildfires on the radioactively contaminated land, in particular the exclusion zone of the Chernobyl NPP, make a serious radio ecological danger. Process of burning promotes intensive involvement of radionuclides in the surface layer of the atmosphere,which leads to transfer of products of burning (smoke aerosols, soot) to long distances. At combustion of forest combustible materials, the formed products of burning are open sources of ionizing radiation. I. M.Abduragimov's research (1993) showed that during a wildfire in the exclusion zone concentration of radionuclides in the air increased almost tens-hundreds times, even at a considerable removal from the fire center. Fall of particles depending on distance to a source of ignition can last from 168 days to 400 years.

152. Tremendous danger of wildfires consists in burning out of a forest ground litter. The forest ground litter is the most polluted type of forest combustible material; its specific activity makes n ($3{,}7x10^{4}$–$3{,}7x10^{3}$) Bq/kg (n$x10^{-6}$..Ki/kg n$x10^{-7}$). The greatest accumulation of forest combustible materials is noted in plantations from 20 to 60 years. Their reserve in absolutely dry state makes from 20,2 to 32,4 t/hectare. Stocks of such forest ground litter combustible material as the fossil grass stands, which during droughty weather intensively support burning process in an exclusion zone, depending on a type of lands, reach from 6,4 to 13,1 t/hectare in absolutely dry state.

153. In pine young stands during the creeping fire from 15 to 30% of a stock of a forest laying burns out: at the lower steady fire – from 44 to 94%, at the upper one the whole forest ground litter burns out as well as combustible material of the ground group. At the same time the mineral layer of soil which has bigger specific pollution with radionuclides than the top layer is partially damaged with thermal influence.

154. Pilot studies of assessment of secondary transfer of radionuclides show that under the most adverse conditions of the forest radioactive fires out of an exclusion zone, secondary transfer of radionuclides won't render a significant contribution to additional pollution of the territory. Increase in pollution of the territory can make up to ten-thousand shares of a percent, in comparison with the existing pollution density. However during wildfires in an exclusion zone, the α-radiating transuranium elements, which are present in forest combustible materials, can lead to combustion at significant increase in the inhalation component of dose loading which can exceed doses of external radiation.

155. It should be noted that the big areas of the polluted territories are outside the 30-kilometer zone. Thus, under the authority of the Ministry of Forestry of the Republic of Belarus the main share of the Republican forests polluted by radionuclides is 83,4%. The area of radioactive pollution of the forest fund, according to UE “Bellesozashchita” as of 1/1/2016 makes 1392,2

thousand hectares (16,7% of the general square) which is 161,9 thousand hectares or 10,4% less in comparison with CY 2011.

Tab. 19. Distribution of the territory of the forest fund of the Ministry of Forestry into zones of radioactive pollution in SFPA (as of 1/1/2016)

SFPA	Area of the forest fund, ths. ha		In each zone of radioactive pollution, ths. ha. %			
	Total	In zones %	1–5 Cu/km^2 %	5–15 Cu/km^2 %	15–40 Cu/km^2 %	>40 Cu/km^2 %
Brest	1282,8	92,4 7,20	89,4 6,97	3,0 0,32	0 0	0 0
Vitebsk	1634,3	0,1 0,01	0,1 0,01	0 0	0 0	0 0
Gomel	1818,2	826,3 45,45	548,2 30,15	203,9 11,21	73,6 4,05	0,6 0,03
Grodno	909,6	29,8 3,28	29,7 3,27	0,1 0,01	0 0	0 0
Minsk	1492,1	31,7 2,12	31,4 2,10	0,3 0,02	0 0	0 0
Mogilev	1212,8	411 33,96	270,8 22,33	93,6 7,72	46,4 3,83	1,1 0,09
Total	**8349,8**	**1392,2 16,67**	**969,6 11,61**	**300,9 3,60**	**120,0 1,44**	**1,7 0,02**

156. The greatest part (70%) of the territory of radioactive pollution of the forest fund belongs to the zone with periodic radiation control with a density of soil pollution with cesium-137 from 1 to 5 Cu/sq.km and the zone with the right for resettlement (5–15 Cu/sq.km) (21%), the others – to zones of the subsequent (15–40 Cu/sq.km) and prime resettlement (> 40 Cu/sq.km).

157. From 2011 to 2015 the area of the forests in the zone of prime resettlement decreased from 5,5 to 1,7 thousand hectares (3,2 times). In the zone of the subsequent resettlement – 23,2 thousand hectares (16,2%). In the zone with the right for resettlement – 7,2 thousand hectares (2,3%). In the zone with periodic radiation control – 117, 7 thousand hectares (10,8%).

158. The greatest part of the «polluted» forests is under the authority of the Ministry of Forestry today and is generally located on the territory of Gomel and Mogilev SFPA. Gomel SFPA takes the dominating place in the Republic in the extent of radiation pollution of forest lands and production of forestry. In various degree more than 44,5% of total area of the forest fund of the area are polluted by radioactive materials, which makes 824,8 thousand hectares on the territory of 20 administrative regions:

- from 1 to 5 Cu/sq.km 551,1 thousand hectares or 29,73% of the territory of the forest fund are polluted;

- from 5 to 15 Cu/sq.km 199,9 thousand hectares or 10,78% of the territory are polluted;

- from 15 to 40 Cu/sq.km 73,2 thousand hectares or 3,95% of the territory are polluted;

- from 40 and more Cu/sq.km 0,6 thousand hectares or 0,03% of the territory are polluted.

159. In Mogilev SFPA in zones with various density of soil pollution with cesium-137 412,5 thousand hectares of the forests, or 33,92% of the total area of the forest fund of the SFPA (1216,2 thousand hectares.):

- from 1 to 5 Cu/sq.km – 271,1 thousand hectares or 22,29% of the territory of the forest fund are polluted;

- from 5 to 15 Cu/sq.km – 93,7 thousand hectares or 7,70% of the territory are polluted;

- from 15 to 40 Cu/sq.km – 46,6 thousand hectares or 3,83% of the territory are polluted;

- 40 and more Cu/sq.km – 1,1 thousand hectares or 0,09% of the territory are polluted.

160. For ranging of forestries according to pollution the coefficient of gravity of radioactive pollution which represents the complex indicator considering pollution of the whole area of forestry in absolute and relative units, the average density of pollution of the territory of forestry and indicators of pollution of separate structural divisions (tab. 20) is used.

The first group of gravity (Ct 500 and more) includes Vetkovsky, Chechersky and Narovlyansky specialized forestries, Krasnopolsky and Cherikovsky forest entities. The group 2 (Ct from 250 to 500) includes Elsky and Hoiniksky forest entities of Gomel SFPA. Bykhovsky forest entity of Mogilev SFPA both Buda-Koshelevsky and Komarinsky forest entities of Gomel SFPA belong to group 3 (Ct from 100 to 50) with severe conditions of activity and the organization of forestry production.

Tab. 20. Distribution of forest entities of the Ministry of Forestry of the Republic of Belarus according to the gravity of radioactive pollution (as of 1/1/2016)

Forest entity	Total area of a forestry, ths.ha	Square of radioactive pollution, ths.ha						Number of forestries		Coefficients					Place according to radioactive gravity	Group of gravity of radioactive pollution
		total ths.ha	Including zones and subzones													
			1-2 Cu/sq.km	2-5 Cu/sq.km	5-15 Cu/sq.km	15-40 Cu/sq.km	40 and more Cu/sq.km	total	polluted	C1	C2	C3	C4	C5		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Vetkovsky	100,1	100,1	0,09	9,26	56,02	34,74		4	4	1,000	100,1	13,728	1,000	1374,173	1	
Chechersky	100,0	100,0	1,49	42,21	43,86	11,84	0,62	7	7	1,000	100,0	8,797	1,000	879,700	2	1
Krasnopolsky	81,5	81,5	3,63	29,38	26,82	21,24	0,41	5	5	1,000	81,5	10,688	1,000	871,072	3	(Ct 500 and more)
Cherikovsky	110,2	99,5	23,63	32,06	32,54	10,55	0,68	9	9	0,903	99,5	7,417	1,000	666,335	4	
Narovlyansky	67,1	67,1	5,41	14,65	40,05	6,96		6	6	1,000	67,1	8,496	1,000	570,082	5	
Elsky	88,2	76,4	18,83	37,59	19,96			8	8	0,866	76,4	3,955	1,000	261,737	6	2
Hoiniksky	64,8	64,6	20,65	32,08	8,43	3,46		7	7	0,998	64,6	4,027	1,000	259,624	7	(Ct from 250 to 500)
Bykhovsky	111,7	77,0	39,19	33,85	3,79	0,16		12	11	0,689	77,0	2,840	0,917	138,184	8	3
Buda-Koshelevsky	51,1	32,6	10,10	9,56	9,86	3,05		6	6	0,638	32,6	5,130	1,000	106,692	9	(Ct from 100 to 250)
Komarinsky	46,7	42,5	19,07	19,47	3,95			5	5	0,910	42,5	2,724	1,000	105,358	10	
Gomel	114,8	44,4	8,79	6,90	15,15	13,54		12	7	0,387	44,4	9,894	0,583	99,109	11	
Kostyukovichky	94,9	36,0	2,63	5,16	14,48	13,75		8	4	0,380	36,0	13,222	0,500	90,438	12	4
Lelchitsky	114,6	68,6	52,36	15,47	0,80			9	9	0,599	68,6	1,830	1,000	75,148	13	(Ct from 25 to 100)
Rogachevsky	78,0	41,6	14,49	23,13	3,93			7	7	0,533	41,6	3,156	1,000	70,021	14	
Stolinsky	91,3	38,3	19,83	15,80	2,74			8	7	0,419	38,3	2,930	0,875	41,191	15	
Chaussky	56,8	30,9	15,48	11,57	3,88			6	4	0,545	30,9	3,314	0,667	37,206	16	
Miloshevichsky	93,6	42,7	33,85	8,85				9	9	0,456	42,7	1,549	1,000	30,174	17	
Vasilevichsky	90,1	34,1	29,84	4,24				10	10	0,378	34,1	1,457	1,000	18,804	18	
Belynichsky	95,6	30,1	18,06	10,99	1,03			9	6	0,315	30,1	2,522	0,667	15,934	19	

Rechitsky	65,7	24,3	19,32	4,76	0,20			6	6	0,370	24,3	1,716	1,000	15,423	20	
Klimovichsky	90,6	20,5	5,54	3,51	10,74	0,68		9	4	0,226	20,5	6,999	0,444	14,429	21	5
Kalinkovichsky	102,8	27,2	22,48	4,75				12	7	0,265	27,2	1,833	0,583	7,695	22	(Ct from 1 to 25)
Loyevsky	44,3	11,4	7,43	2,50	1,49			4	3	0,258	11,4	2,550	0,750	5,625	23	
Luninetsky	145,1	27,8	20,66	6,85	0,28			16	9	0,192	27,8	1,794	0,563	5,369	24	
Mazyrsky	96,5	24,7	20,11	4,63				11	5	0,256	24,7	1,594	0,455	4,581	25	
Polesia	136,0	21,8	18,00	3,79				6	5	0,160	21,8	1,513	0,833	4,406	26	
Ivyevsky	86,0	17,0	15,56	1,39				9	7	0,197	17,0	1,368	0,778	3,563	27	
Mogilev	87,3	17,4	12,97	4,19	0,24			10	5	0,199	17,4	1,8331	0,500	3,178	28	
Zhlobinsky	79,8	15,0	12,52	2,46				9	6	0,187	15,0	1,624	0,667	3,037	29	
Klichevsky	107,1	17,6	15,47	2,09				10	5	0,164	17,6	1,551	0,500	2,243	30	
Berezinsky	109,5	13,5	10,05	3,49				10	7	0,124	13,5	1,773	0,700	2,078	31	
Novogrudsky	97,8	12,1	11,41	0,65	0,12			12	6	0,125	12,1	1,290	0,500	0,976	32	
Zhitkovichsky	102,4	8,6	5,31	3,05	0,24			10	5	0,084	8,6	2,181	0,500	0,788	33	
Volozhinsky	83,8	6,9	4,16	2,39	0,31			8	4	0,082	6,9	2,090	0,500	0,594	34	
Starobinsky	100,3	6,6	6,17	0,47				11	3	0,066	6,6	1,353	0,273	0,160	35	
Pinsky	89,4	4,5	4,49					9	2	0,050	4,5	1,408	0,222	0,071	36	
Krupsky	96,0	1,5	0,80	0,69				11	2	0,016	1,5	2,385	0,182	0,010	37	
Logoysky	111,1	2,2	0,84	1,31				11	1	0,019	2,2	2,370	0,091	0,009	38	6
Goretsky	69,8	1,2	0,38	0,82				8	1	0,017	1,2	2,777	0,125	0,007	39	(Ct less 1)
Dyatlovsky	83,7	0,7	0,62	0,04				9	1	0,008	0,7	1,479	0,111	0,001	40	
Molodechnensky	49,3	0,3	0,13	0,17				5	1	0,006	0,3	2,122	0,200	0,0008	41	
Svetlogorsky	104,6	0,4	0,23	0,17				10	2	0,004	0,4	2,318	0,200	0,0007	42	
Slutsky	60,3	0,3	0,32					6	1	0,005	0,3	1,319	0,167	0,0003	43	
Borisovsky	150,1	0,4	0,45					17	2	0,003	0,4	1,267	0,118	0,0002	44	
Babruysky	124,9	0,2	0,23					12	2	0,002	0,2	1,153	0,167	0,0001	45	
Tolochinsky	59,3	0,1	0,13					6	1	0,002	0,1	1,407	0,167	0,00004	46	
Vileysky	92,4		0,02					10	1	0,0002	0,02	1,480	0,100	0,000001	47	
TOTAL:	4277,0	1392,2	553,22	416,39	300,91	119,97	1,71	414	235							
AVERAGE	91,0	29,6	11,8	8,9	6,4	2,6	0,0	9,0	5	0,3	29,6	3,4	0,6	123,1		

161. Today planning and implementation of forestry actions and forest exploitation within each of the allocated zones are conducted taking into account results of radiation inspection, radiation control and monitoring. In particular, such parameters as density of pollution of the soil with cesium-137, γ-radiation dose power, the content of cesium-137 in forest production are controlled. Implementation of these requirements provides continuous use of forest resources on condition of receiving standardly clean forest production and observance of the set limit of an annual dose of radiation (1 мSv).

162. Forest management in zones of radioactive pollution in organizations subordinated to the Ministry of Forestry is carried out according to the following regulatory and legal and technical regulatory and legal acts:

- TCEP 239-2010 (02080) "Radiation control. Inspection of the felling areas. Order of conduct", approved by the Resolution of the Ministry of Forestry on 2/22/2010, No. 4;

- TCEP 240-2010 (02080) "Radiation control. Inspection of the forest fund lands. Order of conduct", approved by the Resolution of the Ministry of Forestry on 6/28/2010, No. 5;

- TCEP 250-2010 (02080) "Radiation control. Objects of forestry, jobs. Order of conduct", approved by the Rresolution of the Ministry of Forestry on 6/28/2010, No. 14;

- TCEP 251-2010 (02080) "Radiation control. Selection and preparation of tests of forest production. Order of conduct", approved by the Resolution of the Ministry of Forestry on 6/28/2010, No. 14;

- TCEP 498-2013 (02080) "Radiation monitoring of the forest fund. Laying of the permanent observation point. Order of conduct", approved and entered into force by the Resolution of the Ministry of Forestry on 10/3/2013, No. 12;

- TCEP 499-2013 (02080) “Radiation monitoring of the forest fund. Inspection of the permanent observation point. Order of conduct”, approved and put into operation by the Resolution of the Ministry of Forestry on 10/3/2013, No. 12;

- Rules of forest management on the territories which have undergone radioactive pollution as a result of the accident at the Chernobyl NPP, approved by the Resolution of the Ministry of Forestry on 12/27/2016, No. 86;

- Rules of control of radioactive pollution in the system of the Ministry of Forestry of the Republic of Belarus, approved by the Resolution of the Ministry of Forestry on 2/3/2017, No. 36;

- Rules of radiation safety in the system of the Committee on Forestry at the Council of Ministers of the Republic of Belarus. (Rules of radiation safety in the system of the Ministry of Forestry are based on requirements of the Law of the Republic of Belarus “On the legal mode of the territories which have undergone radioactive pollution as a result of the accident at the

Chernobyl NPP", hygienic standards of HN 2.6.1.8-127-2000 "Standards of radiation safety (RSS-2000)"; sanitary regulations and norms 2.6.1.8-8-2002 "The basic sanitary regulations of ensuring radiation safety (BSR-2002)");

- Rules of control of radiation doses in the system of the Committee for Forestry at the Council of Ministers of the Republic of Belarus;

- Rules of control of radiation doses in the system of the Ministry of Forestry establish order of control of radiation doses for forestry workers;

- Rules of carrying out fellings of the forest in zones with a density of soil pollution with cesium-137 15 Cu/sq.km and more.

163. In general, from 1986 to 2016 the territory of the forest fund of the Ministry of Forestry taking into account transfer to structure of the forest fund of contaminated land of other users decreased by 38% (by 1,6 times). Territories of 47 forest entities (235 forestry units) belong to various zones of radioactive pollution. Reduction of the area is connected with reduction of soil pollution density with cesium-137 as a result of its radioactive decay and redistribution into components of forest ecosystems. Eventually as a result of radioactive decay levels of pollution of the territory with radionuclides decrease: there is a transition from a zone with a bigger soil pollution density with cesium-137 to a zone with a smaller one. As a result, the area of the territory of radioactive pollution is reduced (for 2–3% a year).

164. In order to control the radiation situation on the forest territory in 1989 in Belarus systematic work on creation of service of radiation control began. The main objectives of radiation control service are as follows:

- carrying out radiation control of the forest fund lands;

- implementation of radiation control of forest production;

- control of observance of requirements of radiation safety at work in the forest and at objects of forestry;

- control of radiation doses of forestry workers;

- increase of the population and consumers of forest production awareness about the radiation situation in the forests.

165. Systematic observations over the change of radiation situation on the territory of the forest fund of the Republic of Belarus are carried out at permanent observation points of the network of radiation monitoring established in 1993-1995, stationary compartments (2003) and control polygons on the study of long-time pollution of forest food products with cesium-137 (2003-2005). During 1993-1995 in the system of the Ministry of Forestry 102 stationary trial areas – constant points of observation of radiation monitoring in forests, in particular in Gomel SFPA – 45 permanent observation points in 19 forest entities were put into practice.

166. Annually for the purpose of updating the radiation situation, obtaining of staticized data of soil pollution density with cesium-137 radiation survey of forest areas on the territory from 120 to 150 thousand hectares is carried out.

167. Along the network of monitoring the level of soil pollution with cesium-137, parts of the tree trunk (wood, bark, branches, needles and leaves), undergrowth trees, understory species, plants of the field layer, mushrooms are controlled. Results of radiation survey for all period of observations are integrated in the united RadMon database, which allows controlling the dynamics of radioactive pollution of forest phytocenoses, using data for development of forecasts of radiation situation change.

168. In forests that underwent radioactive pollution, soil pollution density with cesium-137 decreases to 2,1% a year in process of reduction of activity of radionuclide as a result of radioactive decay, redistribution in components of forest biogeocenoses.

169. In course of time cesium-137 is released from the forest ground litter, there is its migration in mineral layers of soil, at the same time transition to the mineral part of the soil most intensively happens in plantations with dominance of deciduous species – in mossy and bilberry birch forests.

170. As the density of soil contamination decreases due to the movement of cesium-137 radionuclides along the soil profile, the dose rate decreases. Content of cesium-137 in wood of the main forest forming species decreases, intensity of transition of cesium-137 from the soil into wood decreases. Reduction of cesium-137 is explained by its stable and bound states in the soil, reduction of solubility and, as a result, accessibility (less than 3-4%) in the nutritious chain: from soil to a plant. In the wood growing in the conditions of more fertile soils and low moisturizing, transition of cesium-137 is lower, in comparison with sandy soils in the wet gigrotopes.

171. Eventually there is a reduction of cesium-137 content in wood of undergrowth trees, understory species, and also in field layer plants, berries, mushrooms. The maximum accumulation of the radionuclides is marked in ferns, mosses, heather, and also in mycothalli of the gypsy mushroom, russulas, bay boletus, and the mossiness mushroom.

172. The radiation situation on the territory of radioactive pollution of the forest fund has considerably improved – soil pollution density with cesium-137 and the areas belonging to zones of radioactive pollution have decreased, capacities of a dose of γ-radiation have decreased to values at which doses of external radiation of forestry employees won't exceed an average annual limit in 1 мZivert. Content of cesium-137 in forests steadily decreases, and, as a rule, conforms to requirements of republican admissible levels – the share of tests with excess makes no more than 2% in industrial wood and 5% in firewood. Up to 70% of the firewood prepared in forest

entities of Gomel and Mogilev SFPA don't exceed the level of specific activity of 200 Bq/kg and can be used for burning in industrial boiler installations.

173. Experience of forest management on the territories polluted with radionuclides as a result of the Chernobyl accident has shown that in forests, irrespective of pollution levels, forestry management can't be stopped completely. It is necessary to carry out constantly a complex of preventive actions, protection against injurious organisms and forest diseases and other actions aimed at the increase in efficiency of forests, improvement of their species structure. For planning of forestry management and forest exploitation not only data on the situation in zones of radioactive pollution today, but also expected information on the condition of these territories in the future are necessary. According to forecasts of UE “Bellesozashchita”, by 2020 decrease of the area of forests in zones of radioactive pollution to 1245,0 thousand hectares, by 2046 – to 829,3 thousand hectares is expected.

174. Despite gradual improvement of the situation in general and, in particular in forestry, on the territory of radioactive pollution, now not all problems are solved. Complex character of the problem of overcoming consequences of the Chernobyl accident is caused by the fact that the accident at the Chernobyl NPP affected all aspects of activity of the population and affected territories.

175. Works for overcoming the consequences which arose owing to the accident at the Chernobyl NPP despite the thirty-year period, continue to be conducted, both at the local, and at the international level. On the basis of forest entities of the Republic the organization of educational and practical seminars for radiation control service specialists are constantly carried out. The joint statement on the need to continue work on recovery from the accident at the Chernobyl NPP was adopted on April 26, 2017 at the meeting of heads of Belarus and Ukraine at the Chernobyl NPP. On the same day, in the UN Headquarters in New York, within the International day of remembrance of the Chernobyl disaster, the round table organized by the Permanent mission of Belarus at the UN and the American non-governmental organizations "Chernobyl project" and "The Russian-American fund" took place.

4. DETERMINATION OF THE COMPLEX INDICATOR OF POTENTIAL DANGER OF EMERGENCE AND SPREAD OF THE FOREST FIRES ON THE TERRITORY OF THE LEGAL ENTITIES CONDUCTING FOREST MANAGEMENT IN THE REPUBLIC OF BELARUS

176. The increasing process of involvement in production of goods from different forest resources raises the need of their protection, rational use and production. Such a strategic task is feasible only in case of taking different climatic conditions, structures of the forest fund into consideration. Thus "zoning" is "territorial classification of forestry as a basis for development and use of the rational management system".

177. While developing forest firefighting zoning it is necessary to consider specific climatic, forest vegetation, economical, ecological, organizational and economic factors of the region and in particular in zones of radioactive pollution.

178. In order to update the forest firefighting zoning we calculated the complex index of fire danger of forests for 98 public forest entities of the Ministry of Forestry, as well as 20 enterprises of other legal entities conducting forestry (forestries of the Ministry of Defence, the Ministry of Education, nature protection institutions and others).

179. Based on statistic analysis of wildfires for the last decades, the reasons and the frequency of their origin, duration of a fire-dangerous season the main factors which formed the basis for measure calculation of fire danger of forests (D) were revealed. It is a class of natural fire danger of forests (C), woodiness of the region (W), inflammability of forests (I), population density of the region (P), radioactive pollution gravity (G).

180. After a choice of indices, normalization of values of the initial indices for objects was carried out because basic data are expressed in different units and it is impossible to carry out arithmetical calculations without their transfer to the dimensionless units.

In case of determination of the complex index of potential fire danger the following is considered:

- average class of natural fire danger: 1,9 and < - 30 points; 2,0-2,9 - 20; 3,0-3,9 - 10; 4,0 and> − 0 points.

- group of radioactive pollution gravity Ct 500 and > - 6 points; Ct 250-500 – 5 points; Ct 100-250 – 4 points; Ct 25-100 – 3 points; Ct 1-25 – 2 points; Ct < 1 – 1 point.

For determination of the coefficient of significance of each factor the multiple regression analysis was carried out where fire frequency was considered as an apparent variable, the above-stated factors were considered as free variables (predictors) – (tab. 21).

Tab. 21. Coefficients of the multiple regression describing dependence of frequency of fires on a number of factors

Indicators	BETA	Std.Err. BETA	B	Std.Err. B	t (90)	p-lev.
Constant term	-	-	0,726	0,330	2,202	0,030
Population density	0,424	0,092	0,007	0,001	4,586	0,000
Woodiness	-0,054	0,095	-0,003	0,006	-0,568	0,571
Radioactive pollution gravity	0,015	0,093	0,006	0,037	0,158	0,875
Class of nature fire danger	0,370	0,094	0,010	0,010	1,044	0,299
Inflammability of forests	0,098	0,094	0,057	0,017	3,267	0,002

As we can see in the table, authentic influence of population density and inflammability of the forest fund on the frequency of fires is defined. BETA coefficients are the standard coefficients which can be received if all variables are lead to average 0 and to standard deviation 1. Therefore, BETA coefficients allow comparing the relative contribution of each independent variable to apparent variable. Comparison of BETA coefficients shows that the greatest contribution to value of frequency of fires is made by population density (beta =0,424) and a class of natural fire danger (beta =0,370).

The model of multiple regressions which allowed defining a formula for calculation of potential fire danger was received:

$$D = 0{,}4C + 0{,}4W + 0{,}1I + 0{,}1P + G$$

181. On the basis of the analysis of woodiness, population density of regions and natural fire danger of the forest fund of the legal entities conducting forestry we have calculated the complex indicator of fire danger for 118 organizations (tab. 22).

Tab. 22. Complex regional indicator of fire danger in the forest fund of the Republic of Belarus

Organization	Class of natural fire danger, point [1]	Woodiness of zone of activity of forestry, %	Inflammability of forests	Population density, pers./km^2	Group of radioactive pollution gravity, point [2]	Complex regional indicator of fire danger
1	2	3	4	5	6	7
Brest SFPA						
Baranovichsky forest entity	20	29,0	1,6	92,5	0	29
Brest forest entity	30	37,0	0,8	121,5	0	39
Gantsevichsky forest entity	20	63,0	0,7	17,0	0	35
Drogichinsky forest entity	20	59,8	0,4	21,0	0	34
Ivatsevichsky forest entity	10	41,9	0,3	32,0	0	24
Kobrinsky experimental forest entity	20	25,4	0,8	39,5	0	22

Luninetsky forest entity	20	44,7	0,9	25,0	2	30
Lyakhovichsky forest entity	10	38,0	1,6	20,0	0	21
Maloritsky forest entity	20	45,7	0,3	18,0	0	28
Pinsky forest entity	20	29,0	1,4	20,5	1	23
Polesia forest entity	20	32,5	11,8	22,0	2	26
Pruzhansky forest entity	30	45,0	0,3	17,0	0	32
Stolinsky forest entity	20	34,0	4,6	22,0	3	27
Telekhansky forest entity	20	40,2	0,5	17,0	0	26
Vitebsk SFPA						
Begomlsky forest entity	30	41,6	0,2	11,0	0	30
Beshenkovichsky forest entity	20	28,0	0,4	13,0	0	21
Bogushevsky forest entity	20	38,0	1,1	11,0	0	24
Verkhnedvinsky forest entity	10	41,0	0,2	10,0	0	21
Vitebsk forest entity	10	41,0	0,2	142,7	0	35
Gluboksky experimental forest entity	20	25,9	0,5	22,0	0	21
Gorodoksky forest entity	10	55,3	0,4	8,0	0	27
Disnensky forest entity	10	24,3	0,4	12,0	0	15
Dretunsky forest entity	10	59,8	1,1	34,0	0	31
Lepelsky forest entity	20	40,0	0,5	20,0	0	26
Liozensky forest entity	10	55,5	0,2	11,0	0	27
Orshansky forest entity	20	23,7	2,2	52,5	0	23
Polotsky forest entity	10	55,6	1,3	65,3	0	33
Postavsky forest entity	10	38,0	0,6	15,5	0	21
Rossonsky forest entity	10	68,0	0,5	8,0	0	32
Surazhsky forest entity	10	43,0	0,8	14,0	0	23

Tolochinsky forest entity	20	36,0	1,0	17,0	1	25
Ushachsky forest entity	20	46,5	0,2	9,0	0	28
Shumilinsky forest entity	10	35,5	0,6	11,0	0	19
Gomel SFPA						
Buda-Koshelevsky experimental forest entity	20	23,0	0,5	19,0	4	23
Vasilevichsky forest entity	10	48,0	0,9	30,0	2	28
Vetkovsky specialized forest entity	20	42,8	2,2	11,0	6	32
Gomel forest entity	20	38,0	1,8	284,3	3	55
Elsky forest entity	10	53,3	8,8	12,0	5	32
Zhitkovichsky forest entity	10	54,5	0,6	13,0	1	28
Zhlobinsky forest entity	20	32,0	0.9	48,0	2	28
Kalinkovichsky forest entity	20	48,5	2,0	22,0	2	32
Komarinsky forest entity	20	34,0	0,8	6,0	4	26
Lelchitsky forest entity	20	69,0	31,1	8,0	3	43
Loyevsky forest entity	10	35,4	0,5	12,0	2	21
Miloshevichsky forest entity	10	60,0	11,1	8,0	3	33
Mazyrsky experimental forest entity	20	56,0	2,4	82,0	2	41
Narovlyansky specialized forest entity	20	49,0	1,3	7,0	6	34
Oktyabrsky forest entity	20	57,2	0,3	10,0	0	32
Petrikovsky forest entity	10	53,0	0,7	10,0	0	26
Rechitsky experimental forest entity	10	43,6	0,9	37,0	2	27
Rogachevsky forest entity	20	32,7	0,2	28,0	3	27
Svetlogorsky forest entity	20	54,0	0,5	45,0	1	35

Hoyniksky forest entity	10	45,7	3,8	8,0	5	28
Chechersky specialized forest entity	10	48,0	0,7	14,0	6	23
Grodno SFPA						
Volkovyssky forest entity	30	28,1	0,2	63,1	0	30
Grodno forest entity	30	39,0	3,4	150,3	0	43
Dyatlovsky forest entity	30	44,0	0,4	50,0	1	36
Ivyevsky forest entity	20	42,0	0,5	13,0	2	28
Lidsky forest entity	30	29,1	0,9	52,0	0	29
Novogrudsky forest entity	20	34,2	0,6	24,0	1	25
Ostrovetsky forest entity	30	48,0	0,6	15,0	0	33
Skidelsky forest entity	30	38,3	0,4	86,1	0	36
Slonimsky forest entity	20	36,0	0,7	31,0	0	26
Smorgonsky experimental forest entity	20	88,0	0,6	31,0	0	26
Shchuchinsky forest entity	20	32,0	0,5	22,0	0	23
Minsk SFPA						
Berezinsky forest entity	20	51,0	0,4	12,0	2	32
Borisovsky experimental forest entity	30	50,2	0,3	61,0	1	39
Vileysky experimental forest entity	30	40,4	0,3	20,0	1	31
Volozhinsky forest entity	30	36,9	0,2	18,0	1	30
Kletsky forestry	20	22,5	0,4	38,0	0	21
Kopylsky experimental forest entity	20	17,8	0,2	18,0	0	17
Krupsky forest entity	20	48,0	0,2	11,0	1	29
Logoysky forest entity	20	52,0	0,1	15,0	0	30
Lyubansky forest entity	20	37,0	0,7	17,0	1	26
Minsk forest entity	20	27,0	0,9	45,1	0	23

Molodechnensky forest entity	20	34,0	0,1	98,0	1	32
Pukhovichsky forest entity	20	43,0	0,6	27,0	0	28
Slutsky forest entity	20	21,6	0,5	51,0	1	23
Smolevichsky forest entity	20	35,0	1,3	31,0	0	25
Starobinsky forest entity	20	35,7	0,3	54,0	1	29
Starodorozhsky experimental forest entity	30	50,5	0,3	15,0	0	34
Uzdensky forest entity	20	39,7	0,2	20,0	0	26
Stolbtsovsky forest entity	20	45,6	0,1	21,0	0	28
Chervensky forest entity	20	40,7	0,4	20,0	0	26
Mogilev SFPA						
Belynichsky forest entity	10	41,0	0,7	15,0	2	24
Babruysky forest entity	10	38,0	1,2	12,8	1	22
Bykhovsky forest entity	20	43,7	0,5	14,0	4	31
Glussky forest entity	20	50,0	0,2	11,0	0	30
Goretsky forest entity	10	22,1	1,2	22,3	1	16
Klimovichsky forest entity	10	38,0	0,2	17,0	2	23
Klichevsky forest entity	10	55,8	0,5	9,0	2	29
Kostyukovichsky forest entity	20	33,7	0,3	15,0	3	26
Krasnopolsky forest entity	10	62,4	0,3	9,0	6	36
Mogilev forest entity	20	25,1	2,3	206,5	2	41
Osipovichsky experimental forest entity	10	54,0	1,5	25,0	0	28
Chaussky forest entity	20	31,9	0,2	17,0	3	25
Cherikovsky forest entity	10	38,0	0,5	22,0	6	27
Forest entities of the Ministry of Defence						
Krupsky military forest entity	20	43,0	1,6	11,0	0	27

Ivatsevichsky military forest entity	10	31,0	0,6	19,0	0	18
Forest entities of the Ministry of Education						
Negorelsky educationally experimental forest entity	20	31,0	7,2	53,0	0	26
Polotsk educationally experimental forest entity	10	54,9	0,6	7,6	0	27
Experimental Forest Bases of the Institute of Forest of the NAS of Belarus:						
Dvinskaya EFB	10	27,0	0,2	22,0	0	17
Korenevskaya EFB	20	51,0	1,7	35,0	0	32
Zhornovskaya EFB	10	68,0	0,1	25,0	0	34
Nature Protection Institutions of the Administration of the President of the Republic of Belarus*:*						
NP “Pripyatsky”	10	2,5	53,0	10,0	0	26
SPI "Berezinsky Biosphere Reserve"	10	0,2	50,0	29,0	0	27
NP “Narochansky”	20	0,5	41,0	17,0	0	26
NP “Belovezhskaya pushcha”	10	0,3	24,1	16,0	0	15
NP “Braslau Lakes”	20	0,3	21,4	12,0	0	18
SFI “Teterinskoye”	10	0,1	26,0	16,0	0	16
Department on Mitigation of Consequences of the Accident at the ChNPP:						
Polesye State Radiation-Ecological Reserve	20	56,0	47,0	0,0	6	41,1

182. It has been found out that the greatest value of the regional indicator of fire danger (I) for the forest fund of Grodno SFPA is 30,4, which is connected with dense population of the region (48,8 people/sq.km) and high middle class of natural fire danger (1,9) (fig. 12).

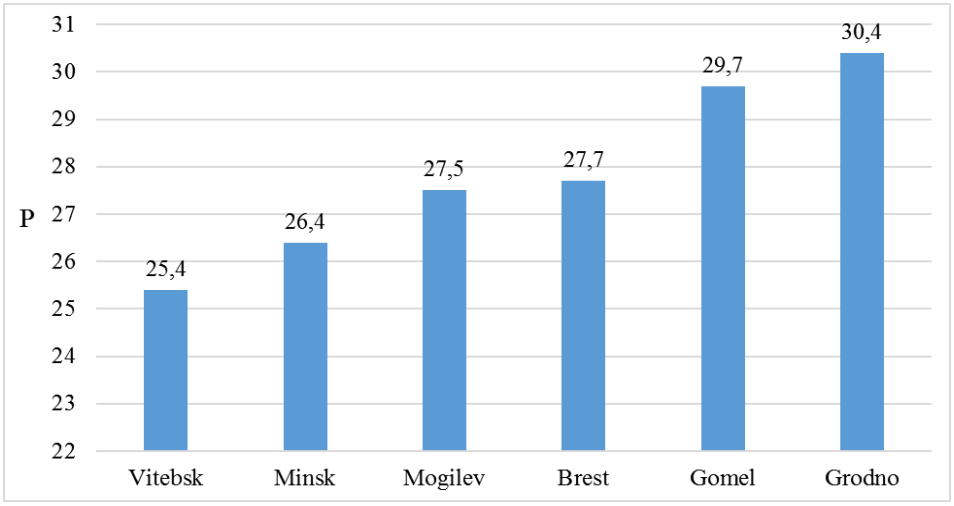


Fig. 12. Average complex indicator of fire danger (I) of the forest fund in SFPA

183. At the same time the maximum complex indicator of fire danger is I=43 for Grodno forest entity with population density of the region of 150, 3 people/sq.km and woodiness of the zone of activity of forestry of 39%, minimum (I =23) – for Shchuchinsky forest entity (population density makes 22 people/sq.km, woodiness of 32%).

184. In SFPA the smallest value of the regional complex indicator of fire danger (I =24) is for the forest fund of Vitebsk SFPA located in the northeast of the Republic. The climate of the region of forest entities, in comparison with other territory of the Republic of Belarus, is the coolest, increasingly damp, with the expressed continentality. At the same time the maximum value of the complex indicator (I =35) is characteristic of Vitebsk forest entity, the minimum one (I =15) – of Disnensky forest entity which are characterized by a low indicator of woodiness of the territory (24,3%).

185. For state forestry institutions located in the southeast and southwest of the Republic (Gomel and Brest SFPA) the value of the complex indicator of fire danger of the forest fund makes from 21 to 55.

186. The highest complex indicator (I =35–55) is characteristic of Gantsevichsky and Brest forest entities of Brest SFPA, as well as Mazyrsky and Gomel forest entities of Gomel SFPA.

187. On the basis of a class of natural fire danger, woodiness and population density of the region, its inflammability, as well as a group of radioactive pollution gravity, the identification of the complex indicator of potential danger of emergence and spread of wildfires on the territory of the legal entities conducting forestry in the Republic of Belarus is made.

5 RECOMMENDATIONS FOR DIFFERENTIATING THE SYSTEM OF FIREFIGHTING ACTIVITIES IN THE FOREST FUND OF THE REPUBLIC OF BELARUS

188. The prevention and elimination of wildfires and their consequences is one of the most urgent and major tasks in forestry. During the dry years, especially in zones of intensive anthropogenous influence, the fires cover significant areas, causing at the same time essential material and ecological damage.

189. Despite annual carrying out in the forest fund of the country of a complex of preventive fire-prevention actions and the use of modern means of early detection and expeditious elimination of ignitions, it isn't possible to prevent their emergence and distribution fully: for 2005-2015 there were about 10 thousand fires on total area over 23,5 thousand hectares, and the sum of annual material and ecological damage from them averages nearly 551,9 thousand dollars.

190. Decrease of economic and ecological consequences caused by wildfires in the forest fund can be reached by improvement and introduction of a multilevel system of prevention, early detection and expeditious elimination of fires, which allows providing ecological integrity of forest biogeocenoses and conservation of biodiversity.

191. For the correct organization of fire-prevention and effective firefighting the territory of the forest fund is divided according to the whole complex of united climatic, forest vegetation, forest pyrologic, economic and some other factors which in the whole determine the need of carrying out identical types and volumes of fire-prevention actions with identical expenses of forces and means for their realization. The solution to this problem depends on forest firefighting zoning of Belarus.

192. One of the major links in the organization of forest fires prevention is also fire-prevention arrangement of the territory of the forest fund including the whole complex of organizational and technical and preventive actions for the prevention of emergence and spread of fires and expeditious detection of the centers of ignition and their suppression taking into account specifics of forest conservation in radiocontamination zones.

193. Lately in view of intensifying climate change influence, as well as density and the area of radiocontamination of the forest fund, there is a transformation in content and structure of vegetation cover and first of all forests. In this regard, it is necessary to improve the system of actions for monitoring of wildfires and fire-prevention arrangement of the forest fund taking into account the staticized card of forest firefighting zoning.

194. The correct organization of fire-prevention in the forest fund and effective fire-fighting requires division of territories uniform in the whole complex of climatic, forest vegetation, forest

pyrologic, economic and some other factors which in the whole determine the need of carrying out identical types and volumes of fire-prevention actions with peer expenses of forces and means for their realization.

195. The purpose of actions for fire-prevention arrangement of the forest fund is to exercise highly effective forest fire prevention, providing a minimum of the caused damage at the minimum negative impact on the environment.

196. Actions for fire-prevention arrangement of the forest fund have to be held with respect for the following basic principles:

- ensuring resistance of forests, their abilities in the maximum degree to perform the nature protection and environment forming functions;
- conservation of biological diversity;
- use of a multilevel highly effective system of prevention and localization of wildfires on the basis of improvement and modernization of security services of forests equipped with modern means of expeditious detection and fight against wildfires of various kinds;
- ensuring rational use of forest resources and favorable environment and ecological safety;
- responsibility for violation of the forest legislation and legislation on environmental protection.

The most important problems of actions for fire-prevention arrangement of the forest fund are:

- prevention of wildfires and creation of conditions for their successful suppression;
- detection of wildfires;
- localization and elimination of wildfires;
- use of evidence-based perspective technologies of forest prevention from fires on the basis of use of highly effective and ecologically safe technical and chemical means;
- prevention of harmful effects on forest biocenoses and environment of economic and other activity.

197. The differentiated system of fire-prevention actions in the forest fund has to include actions for creation in forests of a system of fire-prevention barriers in the form of the barriers and gaps limiting spread of fires in the forest, as well as the structure of a network of roads and reservoirs for ensuring expeditious delivery of services of fire extinguishing and elimination of the arising burning centers.

198. Creation of a system of fire-prevention barriers has to provide division of fire-dangerous forests into the blocks isolated from each other.

199. On the territory of the forest fund, belonging to the I forest fire belt, not less than 0,5 km, II - not less than 0,4 km, III – not less than 0,3 km of fire-prevention gaps on 1000 hectares of the forest fund are arranged. The creation of fire-prevention gaps needs to be carried out by their combination with quarter glades, systems of communications (roads, the power line, cross-overs).

200. The most fire-dangerous coniferous solid wood are divided by fire-prevention gaps or fire-prevention barriers into blocks of 400-1600 hectares for which it is necessary to use first of all the available natural and artificial barriers (a river, a lake, a deciduous forest stand, a road, a glade etc.). Width of fire-prevention gaps at the same time has to be not less than 20 m, fire-prevention barriers – not less than 200 m. The system of fire-prevention gaps along roads has to form the general network allowing to deliver forces and means to any part of the forest area quickly.

201. Large sites of coniferous young growths of natural and artificial origin in forests of the I group, in the presence of economic opportunities should be divided into blocks of 25 hectares perpendicular to the wind pattern. At the same time, when planting forest cultures, it is necessary to pave on both sides mineralized strips or ways of fire prevention or as regulation of natural forest regeneration it is necessary to create fire resistant strips 10 m wide from young plants of deciduous tree and shrubby species.

202. In condition when the strips of the forest with prevalence of deciduous breeds 50-60 m wide are formed on both sides of a rupture, it is allowed to arrange fire-prevention barriers 100-120 m wide.

203. Fire-prevention barriers have to be cleared systematically of dead wood, coniferous subgrowth, fire-dangerous underbrush and fallen trees, and the mineralized strips within barriers have be renewed annually.

204. The preventive mineralized strips are created:

- in plantations of the I class of natural fire danger, around coniferous young growths, forest cultures, on boundaries of valuable forest plantations, specially allotted vacation spots at least 2,8 m wide, in plantations of II and III classes of natural fire danger – at least 1,4 m;

- on boundary of plantations of different classes of natural fire danger, the width of the mineralized strip is set according to the highest class of natural fire danger;

- along the highways and forest roads located in plantations of the I-III classes of fire danger, the mineralized strips are arranged with a respective width of at least 2,8 m and 1,4 m;

- on boundaries of forests and sites of the I-III classes of natural fire danger with agricultural grounds they make mineralized strips of the following width: with a height of dry herbs up to 15 cm – at least 1,4 m, from 15 and more – at least 2,8 m, other grounds – 2,8 m;

- on boundaries and in fire-prevention gaps, barriers and edges, as well as in other places where it is caused by the need of their arrangement, at least 1,4 m wide.

The length of mineralized strips, methods of their creation, the regularity of maintaining them are determined by a forest fire belt, type of conditions of a place of growth and existence of necessary machines and tools for their arrangement.

The mineralized strips should be arranged in addition to a network of roads for formation of closed line.

On the territory of the forest fund, belonging to the I forest fire belt, at least 10 km, II – at least 8 km, III – at least 6 km of the mineralized strip on 1000 hectares of the forest fund are made.

The mineralized strips are arranged throughout a fire-dangerous season and they are maintained; the regularity is determined by conditions of a place of growth and provides their working state.

205. Fire-prevention ditches (at least 1 m) are arranged around especially valuable forest areas located on peat and marsh lands. Fire-prevention ditches are arranged by means of ditchers or excavators and their depth shall reach a mineral layer or the level of ground waters. On the sites which are designed for carrying out meliorative operations, the arrangement of fire-prevention ditches is coordinated with the plan of a meliorative network.

206. Creation and formation of fire resistant forest formations provides a single system of silvicultural, forestry and fire-preventive actions.

207. Methods of increase in fire resistance of the forests consist of directional regulation of the factors determining a level of potential damageability of plantations by different types of fires of the highest intensity.

208. During the creation of fire resistant plantations it is necessary to consider significant differences of tree species in their resistance to influence of the pyrogenic factor of wildfires and ability of some of them to create in plantations the environment with low fire danger.

209. Increase in fire resistance of forests is carried out in the way:

- regulations of the structure of coniferous plantations during intermediate fellings leaving some deciduous breeds, quantity, content and structure of undergrowth and understory;

- formations of fire resistant plantations by creation of mixed coniferous forest cultures with an individual share of deciduous breeds depending on the type of conditions of the place of growth to 5 units;

- timely carrying out intermediate felling of the forest;

- clearings of felling sites;

- creations of fire resistant edges for the purpose of division of fire-dangerous forests into blocks of different size isolated from each other.

210. Fire resistant edges are created in the zones of intensive anthropogenous influence (around the cities and settlements, rest houses and sanatoria, etc.) located close to fire-dangerous coniferous forests.

Fire resistant edges made of deciduous species are created on both sides of railways and highways, borders of large massifs of coniferous forest cultures, with width of 10 m: along railways and highways, along the borders of coniferous cultures, along glades and forest roads not less than 10 m.

Fire resistant edges are created by carrying out intermediate felling of the forest, planting of deciduous plantations or forest stands with prevalence of deciduous breeds (not less than 7 units), not less than 150 meters wide. Along borders of such edges on external and internal (to the forest) sides there must be mineralized strips not less than 2, 8 m wide.

In the absence of a possibility to create the strips from forest stands with prevalence of deciduous species the creation of a fire-prevention edge from coniferous species, whose width has to make 250–300 m, is allowed. In coniferous forest stands, adjacent to a fire-prevention gap, on strips of 100 meters wide from each side, it is necessary to make cleaning of wood stuff, coniferous undergrowth and fire-dangerous understory. Strips of the coniferous forest are divided by mineralized strips in the axial direction every 50 m. The lower branches and boughs of trees of the II class of age are removed to the height of 2 m.

At the arrangement of fire resistant edges from forest stands with prevalence of fire resistant species in the artificial way during creation of forest cultures economic and valuable deciduous tree species are mainly used, according to forest vegetation conditions (the oak, the birch, the maple, the ash-tree, the linden, the mountain ash, etc.).

Fire-fighting reservoirs have to be not less than 100 m^3 with depth of 1,3 m during the hottest period of summer.

211. The network of forest roads on the territory of the forest fund has to provide transport availability of the forest site and timely expeditious delivery of forces and fire extinguishing means to places of fire in the determined standard time.

Depending on appointment, forestry and fire-prevention forest roads are arranged. The arrangement of roads has to be carried out according to standard projects and provide free trip of all types of motor transport while transiting necessary freights, as well as deliver forces and fire extinguishing means.

Roads of fire-prevention appointment are arranged in addition to the network of forest roads of economic appointment for ensuring transportation of motor transport to fire-prevention reservoirs and fire-dangerous forests.

Planning and construction of forest roads has to be carried out so that they at the same time can be barriers to distribution of the possible local fires and basic lines at their elimination. When planning the construction of forest roads it is necessary to consider the need of the maximum use of forest roads, as well as those which are in forests and are of public use.

212. The network of fire reservoirs is created by the corresponding preparation of natural water sources (small rivers, lakes, etc.) and construction of special artificial fire reservoirs.

Preparation of natural water sources for extinguishing consists in arrangement of access to them, the equipment of special platforms for water intake by fire fuel trucks and motor-pumps, and, in special cases, in deepening of reservoirs.

Along roads and on fire-prevention gaps signs of firefighting reservoirs are put.

Artificial fire-prevention reservoirs are constructed as per the standard engineering projects, as a rule, near the improved highways that will provide access to the reservoirs.

The effective water-supply in forest fire-prevention reservoirs has to be not less than 100 m^3 with a depth of 1,3 m during the hottest period of summer.

6. DEVELOPMENT OF RECOMMENDATIONS FOR DIVIDING THE TERRITORY OF THE REPUBLIC OF BELARUS INTO FOREST FIRE ZONES ON THE BASIS OF THE REGIONAL COMPLEX INDICATOR OF THE POTENTIAL DANGER

213. The correct organization of fire-prevention and effective firefighting require separation of territories of the forest fund which are united in the whole complex of climatic, forest vegetation, pyrologic, economic and some other factors, which in the whole, determine the need of carrying out identical types and volumes of fire-prevention actions with similar expenses of forces and means for their realization. The solution to this problem depends on the improvement of the existing forest firefighting zoning of the territory of Belarus.

214. The need for distribution of the forest territory into the sites, which are similar according to major factors of inflammability, was mentioned in a great number of scientific works (Skvoretsky, 1955; Makeev, 1962; Kurbatsky, 1963; Sheshukov, 1982; Inshakov, 2008; Gursky, 2011, etc.). The great attention to problems of zoning was paid by I. S. Melekhov (1946) who, on the basis of studying of statistics of wildfires and climatic conditions, divided the territory of the European part of the USSR into fire belts which differed in time of emergence of wildfires and duration of fire-dangerous seasons.

215. A series of signs of climatic character, in particular geographic latitude, calendar terms of snow cover melt, spring and summer dry period, and as a result of it, fire-dangerous weather and emergence of fires, were put at the basis of division of the territory of the European part of the USSR, Siberia and the Far East.

216. Forest fire division into districts of the forest fund of the Altai Republic is carried out with the use of data on costs of conducting forestry and protection of the forest, as well as the number of wildfires and the area undergone by fire (Paramonov, 2008; Terekhov, 2008). At the same time it is rational to carry out preliminary separation of the territory into forest fire districts and areas with the use of physiographic and climatic maps. As the main district forming factors it is necessary to accept the actual inflammability of forests, state and features of forest vegetation (species structure, woodiness, degree of marshiness of the territory), tension and duration of a fire-dangerous season, density of anthropogenous sources of fire (economic familiarity of the territory).

217. N. G. Nikishchenko (2007) distributed administrative regions of Voronezh district across the area with small, moderate, high and very high danger of origin of wildfires on the territory of the forest fund. The technique of score assessment of six factors, such as population density, woodiness of the region, a share of pine plantations, moistening coefficient, the relation of the amount of precipitation to average temperature of air in June-August, lands with steepness of slopes of more than 5^0 were taken as a basis.

218. Now many researchers note that the perspective direction while planning and carrying out research on forest firefighting zoning are multivariate classification methods of mathematic and statistical analysis of territorially isolated objects described by a set of natural factors (Nikishchenko, 2007; Demakov, 2009, etc.). It is recommended to conduct research of spatial structure of the forest fund using cluster analysis and separation of united territorial sections of different rank.

219. Thus, we can note that there is no uniform development approach for forest firefighting zoning and all renowned diagrams and principles have individual approach.

220. On climatic, soil and hydrological, forest pyrologic, ecological, economic and other conditions the territory of Belarus is divided into three forest fire belts; for each forest fire belt volumes of actions for fire-prevention arrangement of the forest fund are determined.

221. While updating the forest firefighting zoning a long-term statistic analysis of quantity of wildfires for the last decades was carried out, the reasons and the frequency of their origin, duration of a fire-dangerous season and the significance of the coefficients for each factor which determine the regional index of fire danger of the forest fund of legal entities conducting forestrywere defined. These factors are: natural fire danger of forests; woodiness of the region;

inflammability of forests, population density of the region; radioactive pollution gravity. Probability of origin of cross-border fires, territorial layouts of forests, intensity of anthropogenous burden were also considered.

222. The organizations conducting forestry were classified (grouped) by means of two methods of cluster analysis: a method of creation of cluster trees that is applied for finding out the quantity of classes and approximate structure of classes, and a method of k-averages for direct division of the classes. As initial centers of clusters the observations maximizing initial distances between clusters were selected. For assessment of quality of clustering values of intergroup and intra group dispersions of indices were compared (tab. 23).

Tab. 23. Average values of clusters received as a result of distribution of the organizations conducting forestry in forest fire belts

Average values of clusters			
	Cluster 1	Cluster 2	Cluster 3
Population density	195,95	67,95	17,53
Woodiness of region	35,78	36,84	42,67
Radioactive pollution gravity	1,25	0,59	1,32
Inflammability of forests	1,93	0,79	1,54
Natural fire danger	20,00	22,94	17,07
Fire frequency	2,45	1,25	0,98
Complex indicator of firedanger	**43,35**	**31,37**	**27,12**

223. The existing and updated map of forest firefighting zoning of the territory of Belarus is presented in fig. 13 and 14.

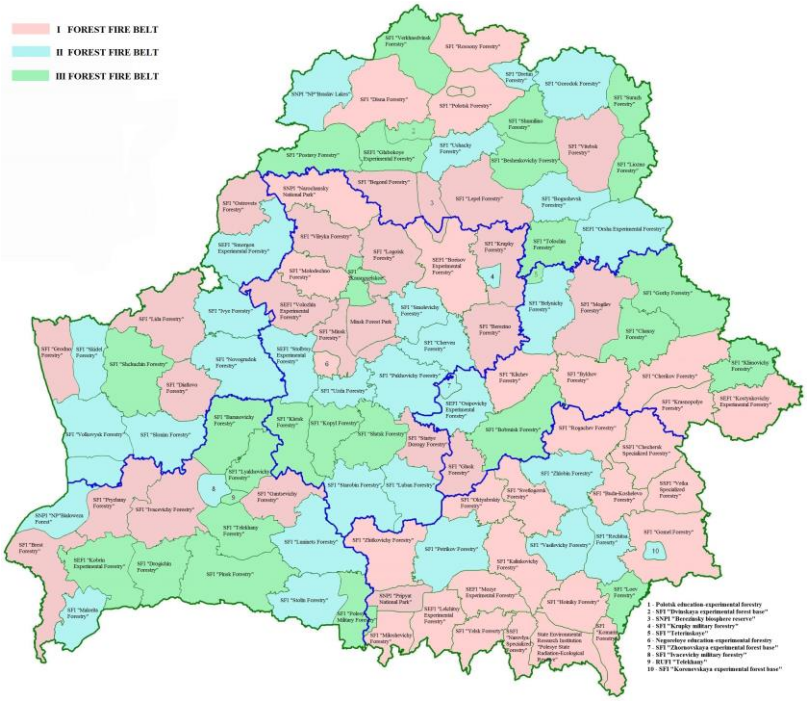


Fig. 13. The existing map of forest firefighting zoning of the territory of Belarus

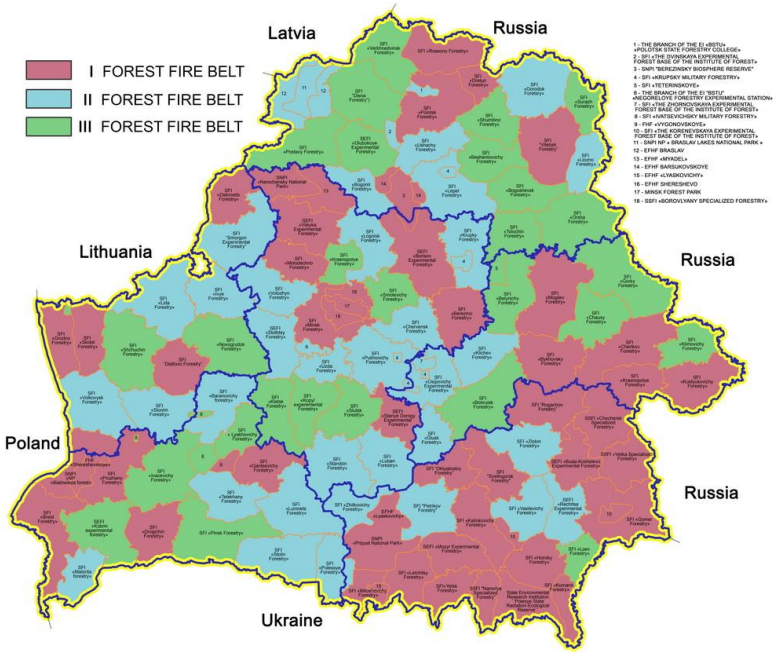


Fig. 14. The updated map of forest firefighting zoning of the territory of Belarus

224. The updated map of forest firefighting zoning of the territory of Belarus differs from the existing one in distribution of the organizations conducting forestry for forest fire belts. So, 49 enterprises (earlier 52) belong to the I forest fire belt, 40 (34) - to the II belt, 29 (27) - to the III belt (tab. 24).

Tab. 24. Distribution of the number of the legal entities conducting forestry according to forest fire belts

Forest fire belt	Number of organizations	% of the total number
I	49	41,5
II	40	33,9
III	29	24,6
Total	**118**	**100,0**

225. At the same time the greatest number of the legal entities conducting forestry (15), belonging to the forest fire belt I, is on the territory of the forest fund of Gomel SFPA (tab. 25). The smallest quantity is on the territory of Brest, Vitebsk and Grodno SFPA. More than 50% of forestry institutions of Vitebsk SFPA belong to the III forest fire belt. Forest entities of Mogilev and Minsk SFPA are distributed as follows: the I forest fire belt makes 38 and 35% (from total of forest entities) respectively, II – 24 and 45%, III – 38 and 20% respectively.

Tab. 25. The complex regional indicator of fire danger of the forest fund of the legal entities conducting forestry in the Republic of Belarus

Organization	Class of natural fire danger, point [1]	Woodiness of the zone of activity of a forestry, %	Inflammability of forests	Population density , pers./km^2	Group of radioactive pollution gravity, point [2]	Complex regional indicator of fire danger , ***I***
1	2	3	4	5	6	7
forest fire belt I						
Brest forest entity	30	37,0	0,8	121,5	0	39
Gantsevichsky forest entity	20	63,0	0,7	17,0	0	35
Drogichinsky forest entity	20	59,8	0,4	21,0	0	34
Pruzhansky forest entity	30	45,0	0,3	17,0	0	32
Vitebsk forest entity	10	41,0	0,2	142,7	0	35
Dretunsky forest entity	10	59,8	1,1	34,0	0	31
Polotsky forest entity	10	55,6	1,3	65,3	0	33
Rossonsky forest entity	10	68,0	0,5	8,0	0	32
Buda-Koshelevsky experimental forest entity	20	23,0	0,5	19,0	4	23*
Vetkovsky specialized forest entity	20	42,8	2,2	11,0	6	32*
Gomel forest entity	20	38,0	1,8	284,3	3	55*
Elsky forest entity	10	53,3	8,8	12,0	5	32*
Kalinkovichsky forest entity	20	48,5	2,0	22,0	2	32
Komarinsky forest entity	20	34,0	0,8	6,0	4	26*
Lelchitsky forest entity	20	69,0	31,1	8,0	3	43*
Miloshevichsky forest entity	10	60,0	11,1	8,0	3	33
Mazyrsky experimental forest entity	20	56,0	2,4	82,0	2	41
Narovlyansky specialized forest entity	20	49,0	1,3	7,0	6	34*
Oktyabrsky forest entity	20	57,2	0,3	10,0	0	32
Rogachevsky forest entity	20	32,7	0,2	28,0	3	27*
Svetlogorsky forest entity	20	54,0	0,5	45,0	1	35
Hoyniksky forest entity	10	45,7	3,8	8,0	5	28*
Chechersky specialized forest entity	10	48,0	0,7	14,0	6	23*
Grodno forest entity	30	39,0	3,4	150,3	0	43
Dyatlovsky forest entity	30	44,0	0,4	50,0	1	36
Ostrovetsky forest entity	30	48,0	0,6	15,0	0	33
Skidelsky forest entity	30	38,3	0,4	86,1	0	36
Berezinsky forest entity	20	51,0	0,4	12,0	2	32

Borisovsky experimental forest entity	30	50,2	0,3	61,0	1	39
Vileysky experimental forest entity	30	40,4	0,3	20,0	1	31
Borovlyansky forest entity	20	28,0	4,6	157	0	35
Minsk forest entity	20	27,0	0,9	157	0	34,6
Molodechnensky forest entity	20	34,0	0,1	98,0	1	32
Starodorozhsky experimental forest entity	30	50,5	0,3	15,0	0	34
Bykhovsky forest entity	20	43,7	0,5	14,0	4	31*
Kostyukovichsky forest entity	20	33,7	0,3	15,0	3	26*
Krasnopolsky forest entity	10	62,4	0,3	9,0	6	36*
Cherikovsky forest entity	10	38,0	0,5	22,0	6	27*
Mogilev forest entity	20	25,1	2,3	06,5	2	41
State unitary enterprise "The Minsk forest-park enterprise"	20	28,0	4,6	157	0	35
Korenevsky EFB	20	51,0	1,7	35,0	0	32
SPU "Berezinsky Biosphe Reserve" **	10	48,9	50,0	29,0	0	27
NP "Narochansky" **	20	39,0	41,0	17,0	0	26
NP "Pripyatsky"	10	52,4	53,0	10,0	0	26
Polesye State Radiation-Ecological Reserve	20	56,0	47,0	0	6	41,1
forest fire belt II						
Baranovichsky forest entity	20	29,0	1,6	92,5	0	29
Luninetsky forest entity	20	44,7	0,9	25,0	2	30
Maloritsky forest entity	20	45,7	0,3	18,0	0	28
Polesia forest entity	20	32,5	11,8	22,0	2	26
Stolinsky forest entity	20	34,0	4,6	22,0	3	27
Telekhansky forest entity	20	40,2	0,5	17,0	0	26
Begomlsky forest entity	30	41,6	0,2	11,0	0	30
Gorodoksky forest entity	10	55,3	0,4	8,0	0	27
Lepelsky forest entity	20	40,0	0,5	20,0	0	26
Liozensky forest entity	10	55,5	0,2	11,0	0	27
Ushachsky forest entity	20	46,5	0,2	9,0	0	28
Vasilevichsky forest entity	10	48,0	0,9	30,0	2	28
Zhitkovichsky forest entity	10	54,5	0,6	13,0	1	28
Zhlobinsky forest entity	20	32,0	0.9	48,0	2	28

Petrikovsky forest entity	10	53,0	0,7	10,0	0	26
Rechitsky experimental forest entity	10	43,6	0,9	37,0	2	27
Volkovyssky forest entity	30	28,1	0,2	63,1	0	30
Ivyevsky forest entity	20	42,0	0,5	13,0	2	28
Lidsky forest entity	30	29,1	0,9	52,0	0	29
Slonimsky forest entity	20	36,0	0,7	31,0	0	26
Smorgonsky experimental forest entity	20	88,0	0,6	31,0	0	26
Volozhinsky forest entity	30	36,9	0,2	18,0	1	30
Krupsky forest entity	20	48,0	0,2	11,0	1	29
Logoysky forest entity	20	52,0	0,1	15,0	0	30
Lyubansky forest entity	20	37,0	0,7	17,0	1	26
Pukhovichsky forest entity	20	43,0	0,6	27,0	0	28
Starobinsky forest entity	20	35,7	0,3	54,0	1	29
Stolbtsovsky forest entity	20	45,6	0,1	21,0	0	28
Uzdensky forest entity	20	39,7	0,2	20,0	0	26
Chervensky forest entity	20	40,7	0,4	20,0	0	26
Glussky forest entity	20	50,0	0,2	11,0	0	30
Klichevsky forest entity	10	55,8	0,5	9,0	2	29
Osipovichsky experimental forest entity	10	54,0	1,5	25,0	0	28
Krupsky military forest entity	20	43	1,6	11	0	27
Dwinskaya EFB	10	27,0	0,2	22,0	0	17
Zhornovskaya EFB	10	52,0	0,1	25,0	0	28
Negorelsky educationally experimental forest entity	20	31,0	7,2	53,0	0	26
Polotsk educationally experimental forest entity	10	54,9	0,6	7,6	0	27
NP "Belovezhskaya pushcha" **	10	0,3	24,1	16,0	0	15
NP "Braslau lakes" **	20	0,3	21,4	12,0	0	18
forest fire belt III						
Ivatsevichsky forest entity	10	41,9	0,3	32,0	0	24
Kobrinsky experimental forest entity	20	25,4	0,8	39,5	0	22
Lyakhovichsky forest entity	10	38,0	1,6	20,0	0	21

Pinsky forest entity	20	29,0	1,4	20,5	1	23
Beshenkovichsky forest entity	20	28,0	0,4	13,0	0	21
Bogushevsky forest entity	20	38,0	1,1	11,0	0	24
Verkhnedvinsky forest entity	10	41,0	0,2	10,0	0	21
Gluboksky experimental forest entity	20	25,9	0,5	22,0	0	21
Disnensky forest entity	10	24,3	0,4	12,0	0	15
Orshansky forest entity	20	23,7	2,2	52,5	0	23
Postavsky forest entity	10	38,0	0,6	15,5	0	21
Surazhsky forest entity	10	43,0	0,8	14,0	0	23
Tolochinsky forest entity	20	36,0	1,0	17,0	1	25
Shumilinsky forest entity	10	35,5	0,6	11,0	0	19
Loyevsky forest entity	10	35,4	0,5	12,0	2	21
Novogrudsky forest entity	20	34,2	0,6	24,0	1	25
Shchuchinsky forest entity	20	32,0	0,5	22,0	0	23
Kletsky forest entity	20	22,5	0,4	38,0	0	21
Kopylsky experimental forest entity	20	17,8	0,2	18,0	0	17
Slutsky forest entity	20	21,6	0,5	51,0	1	23
Smolevichsky forest entity	20	35,0	1,3	31,0	0	25
Belynichsky forest entity	10	41,0	0,7	15,0	2	24
Babruysky forest entity	10	38,0	1,2	12,8	1	22
Goretsky forest entity	10	22,1	1,2	22,3	1	16
Klimovichsky forest entity	10	38,0	0,2	17,0	2	23
Chaussky forest entity	20	31,9	0,2	17,0	3	25
Ivatsevichsky military forest entity	10	31	0,6	19	0	18
SFI "Teterinskoye"	10	0,1	26,0	16	0	16

Note:
* The forest fire belt corresponds to the radioactive pollution gravity (Kt =250 and more).
** National Parks and Reserves of the republican value belong to one forest fire belt higher than those belonging to the complex indicator.

226. While distributing financial and production resources to protection of the forest it is necessary to consider forest firefighting zoning and the regional indicator of fire danger of forests taking into consideration the legal entities conducting forestry.

7. RECOMMENDATIONS FOR UPDATING THE FIREFIGHTING ZONING OF THE REPUBLIC OF BELARUS

7.1 Preventive actions for forest protection

227. Humans are mainly responsible for wildfires – our negligence when using fire in the forest during work and while resting. The majority of fires result from agricultural burnings, burning of garbage, in places of picnics, collecting mushrooms and berries, during hunting, from the thrown burning match, not extinguished cigarette. At the weekends the number of fires in the forest reaches 40% of their number during a week; and in the ten-kilometre zone around settlements, which is the most visited by the population zone, there are about 93% of all fires.

228. Within the last ten years near large cities of the Republic there were 1533 fires on the total area of 1111,42 hectares, including only in 2015 166 fires on the area of 215,73 hectares (tab. 26).

Tab. 26. Dynamics of wildfires in districts of the large cities of the Republic of Belarus (2006-2015)

Organizations	2006–2015 years		
	Number of fires	Area, undergone by fires, ha	Average area of a fire, ha
Baranovichsky forest entity	52	138,40	2,66
Babruysky forest entity	285	140,20	0,49
Borisovsky forest entity	106	42,75	0,40
Brest forest entity	100	55,46	0,55
Vitebsk forest entity	49	10,79	0,22
Gomel forest entity	215	205,75	0,96
Grodno forest entity	203	196,32	0,97
Minsk forest entity	49	36,95	0,75
Mogilev forest entity	275	168,00	0,61
Pinsky forest entity	199	116,80	0,59
Total	**1533**	**1111,42**	**0,72**
including the year of 2015			
Baranovichsky forest entity	8	77,55	9,69
Babruysky forest entity	26	51,75	1,99
Borisovsky forest entity	12	7,36	0,61
Brest forest entity	12	26,25	2,19
Vitebsk forest entity	7	4,66	0,67
Gomel forest entity	9	12,04	1,34
Grodno forest entity	18	5,07	0,28

Minsk forest entity	-	-	-
Mogilev forest entity	43	20,64	0,48
Pinsky forest entity	31	10,41	0,34
Total	**166**	**215,73**	**1,70**

229. The greatest number of fires was registered in Babruysky and Mogilev forest entities (285 and 275 cases), the smallest – in Vitebsk and Baranovichsky forest entities – 49 and 52 cases respectively. At the same time the largest area which was undergone by fires is noted in Gomel forest entity – 205, 75 hectares, including in 2015 – 12, 04 hectares.

The low average area of a fire per year for the long-term period of observation (0,72 hectares) shows expeditious detection and elimination of wildfires, good transport security and availability.

230. Long-term dynamics of fires in the forest fund of Belarus demonstrates that the suppressing quantity of them arises because of breaking the rules of fire safety by people during staying in the forest. In this regard, one of the major measures for decrease of the number of ignitions and the fire area is mass and explanatory and educational work among the population.

231. Forest firefighting promotion represents a set of information and propaganda means and actions aimed at formation of public opinion for prevention of emergence of wildfires and is a part of nonconsumptive promotion.

232. Promotion of forest firefighting awareness in labor collectives and educational institutions has to be carried out taking into account professional interests, educational level, and at the certain place of residence and among certain citizens – also their psychology, awareness, skills and other features of character. At the same time special attention needs to be paid to those issues that are most important in respect of prevention of wildfires by the category of the population of a specific social group.

233. Forms of forest fire promotion may be different: meetings, conferences, seminars, radio and tv-programms, experts' lectures, conversations, thematic exhibitions where theoretical and practical problems of forest fire prevention are discussed. Methods of promotion are bound to receptions and ways of supply of the promotional material, its distribution, bringing data to listeners, readers, the audience. The following methods of forest firefighting promotion may be used: display of illustrative material (stands, posters, photos), demonstration of objects (sites of burning and burned forests), indication of the reasons for the consequences of careless handling of fire in the forest (not extinguished fire, the burning match) leading to fire of the ground cover and the fire in the forest. As methods of promotion performances of witnesses of wildfires, experts in the field of forest prevention from fires may be used.

234. One of the most effective means of forest fire promotion, which allows disclosing in detail the content of the described events, the facts, is the press. The reader, at discretion and if necessary, can repeatedly come back to the publication.

235. Depending on a type of printed materials (article in the newspaper or in the magazine, the leaflet, the booklet) the contents and efficiency of submission of information are various. In newspaper articles, booklets the urgent materials, that are intended for non- specialist audience, are placed. Less urgent, more fundamental materials are located in instructions, journal articles, and books.

236. One of the common forms of impact on beliefs and actions of people is visual propaganda. Advantages of such propaganda consist in a combination of figurativeness, brevity, concentration of contents, and a possibility to place the material on forest fire prevention in various places, which promotes the increase in efficiency of perception of information.

237. For the purpose of drawing attention of citizens to the problem of forest fire prevention it is necessary to think over the art use of notices, posters and announcements. While being installed near highways they must be short, written in large letters, well-readable along the run of the car. Drawings should be given schematically, without excess details that their sense was clear at a single glance. During the fall period all notices and announcements are removed, and in the spring they are renewed and put up again (fig. 15).

Fig. 15. Preventive notices at the entrance to the forest

238. In the leaflets the updated information about the fire-dangerous situation in the forest has to be quickly reflected (the number of the arisen fires, damage from them, the main reasons for emergence of wildfires).

239. During the periods of hot dry weather, therefore, and the increased fire danger in the forest the inflow of campers increases. At this time patrol of forests in places of mass rest of the people has to amplify as much as possible, especially at the weekend. In multiforest areas during the periods of the increased fire danger additional, proceeding from local conditions, measures of fire safety in places of mass rest of the population should be organized. Owners of vehicles should have in each car the minimum necessary fire-prevention stock (a bucket, an axe, a shovel, etc.). The responsible person for observance of fire safety regulations in the forest is appointed. At the main departures from the city joint posts of a state traffic inspections and the state forest protection which stop cars, check implementation of these requirements and hand an instruction with fire safety regulations in the forest should be organized.

240. During the fire-dangerous season workers of the state forest protection services, fire inspectors and volunteers, public inspectors for protection, members of school forestries exercise constant control for observance of fire safety regulations in forests.

241. Workers of the state forest protection demand holding actions for improvement of constant tourist routes and parking from touristic organizations, during the fire-dangerous season provide observation in places of parking and strengthen protection of the forest on tourist routes.

242. The creation of a system of fire-prevention barriers in the form of fire-prevention gaps and barriers, fire resistant edges, protective mineralized strips also belong to preventive actions for protection of the forest, fire-prevention ditches for the purpose of division of fire-dangerous forests into the blocks of different size (fig. 16, 17, 18) isolated from each other.

Fig. 16. 40-meter fire-prevention gap in plantations of the I class of natural fire danger

Fig. 17. 20-meter fire-prevention gap in plantations of the I class of natural fire danger

Fig. 18. The mineralized protective strip in plantations of the I-III classes of natural fire danger

7.2 Recommendations for updating the firefighting zoning of the Republic of Belarus

243. Recommendations for updating the firefighting zoning are presented in the form of the Amendment No. 1 to TCEP 193-2009 (02080) "Rules of firefighting arrangement of forests of the Republic of Belarus ". Amendment No. 1 is approved by the Resolution of the Ministry of Forestry of the Republic of Belarus No. 6 as of April 28, 2017 and will be put into actions since July 1, 2017. (Appendix B).

CONCLUSION

244. Based on the long-term statistic analysis of the quantity of wildfires for the last decades, the reasons and the frequency of their origin, duration of a fire-dangerous season, probability of origin of cross-border fires, territorial layout of forests, the main factors, which determine the forest fire characteristic and are the basis for calculation of the index of fire danger of the forest fund of the organizations conducting forestry, were revealed.

245. In order to improve the forest firefighting zoning of Belarus we calculated the regional complex index of fire danger of forests for 98 forest entities of the Ministry of Forestry, as well as for 20 other organizations conducting forestry.

246. Based on the analysis of the complex indices of fire danger of forest of the forest fund of legal entities conducting forestry, as well as considering the level of anthropogenous influence on their territories taking into account the length of boundaries of the forest fund with settlements and their remoteness from forests, radioactive pollution gravity and the mode of forestry management, the diagram of division of the territory into forest fire belts was offered and three forest fire belts were selected.

247. Developed recommendations for differentiating the system of fire-prevention arrangement of the forest fund include actions for creation of the system of fire-prevention barriers in the form of gaps, mineralized bands restricting the spread of fires in the forest as well as the development of a network of roads and reservoirs for support of operational delivery of fire extinguishing services and elimination of the originating centers of burning, taking into account the devision of institutions in accordance with the forest fire belts.

248. Recommendations for updating the firefighting zoning are presented in the form of the Amendment No. 1 to TCEP 193-2009 (02080) "Rules of firefighting arrangement of forests of the Republic of Belarus ". Amendment No. 1 is approved by the Resolution of the Ministry of Forestry of the Republic of Belarus No. 6 as of April 28, 2017 and will be put into actions since July 1, 2017. (Appendix B).

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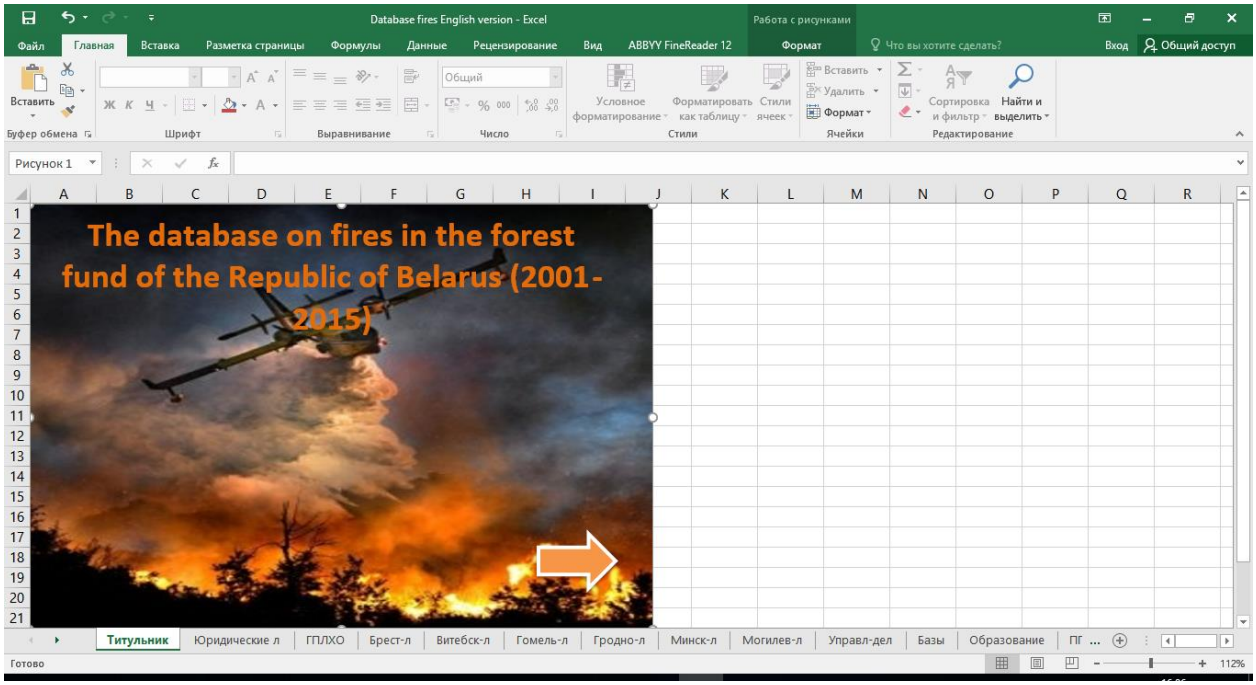
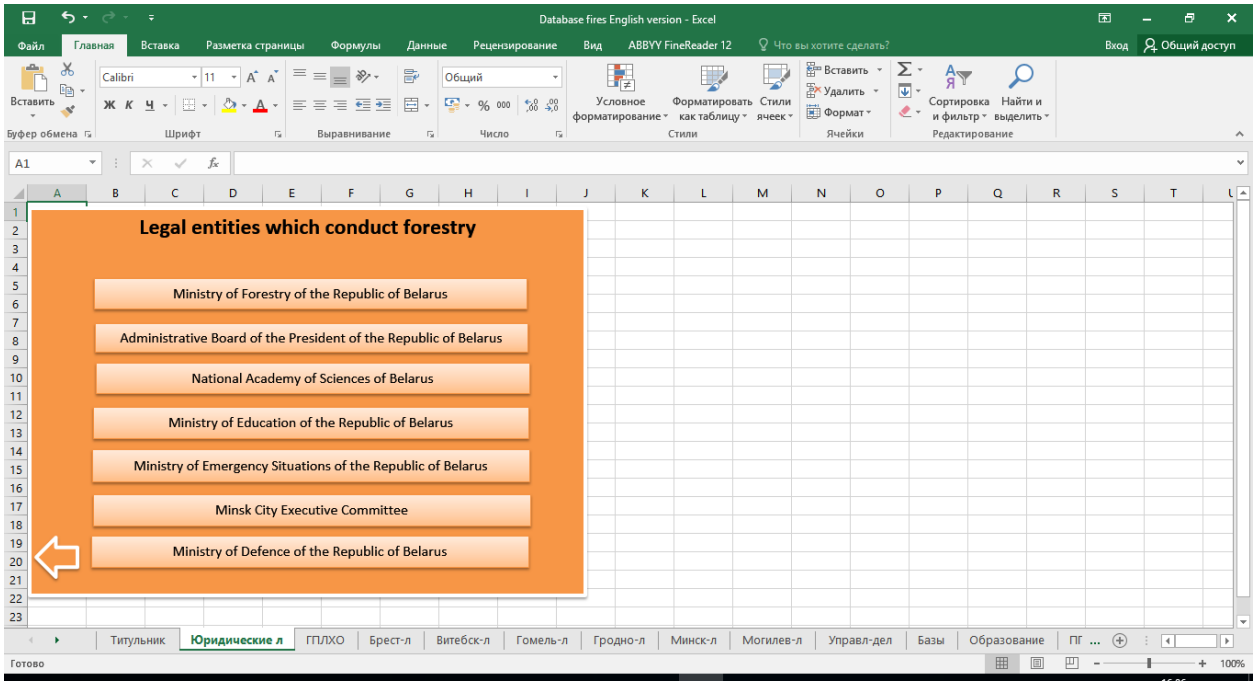
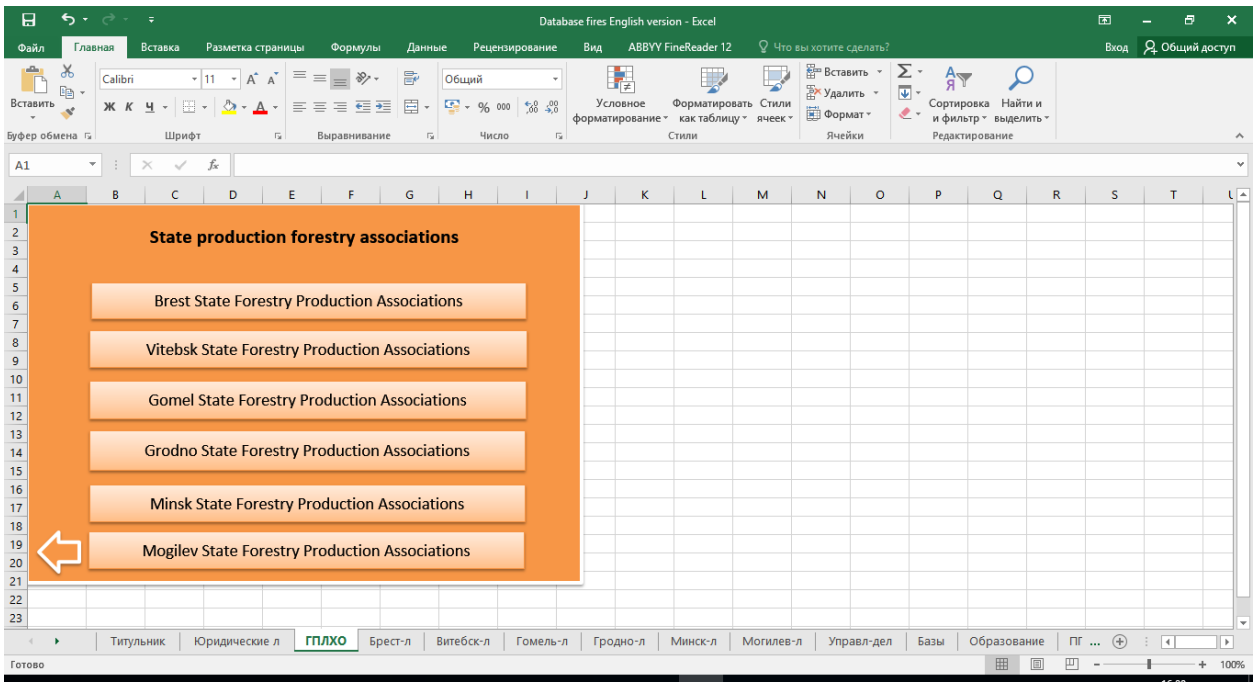
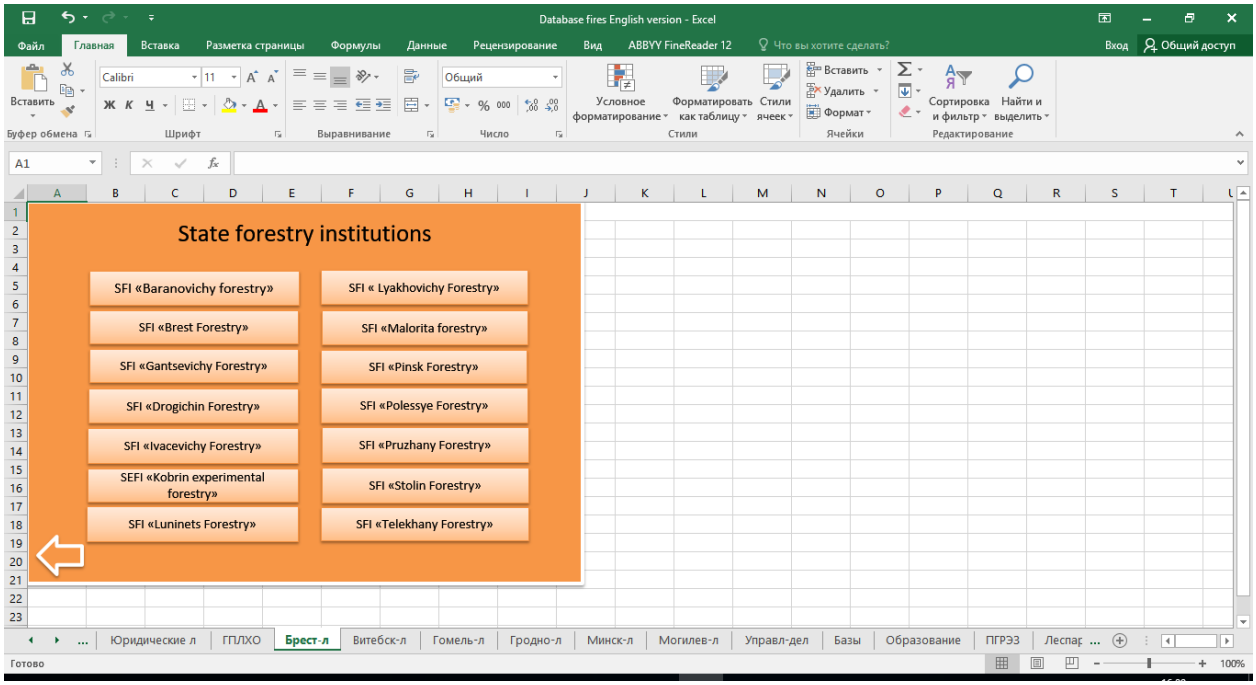
ANNEX A

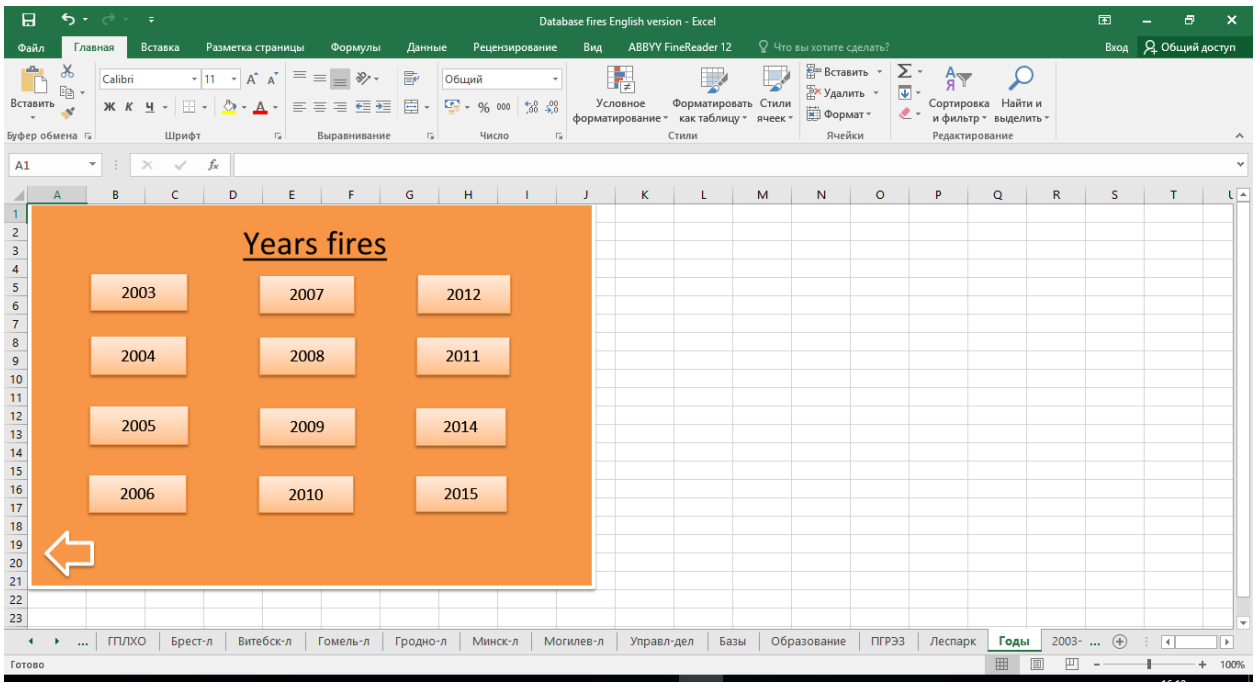
Photos of the database on fires in the forest fund of the Republic of Belarus





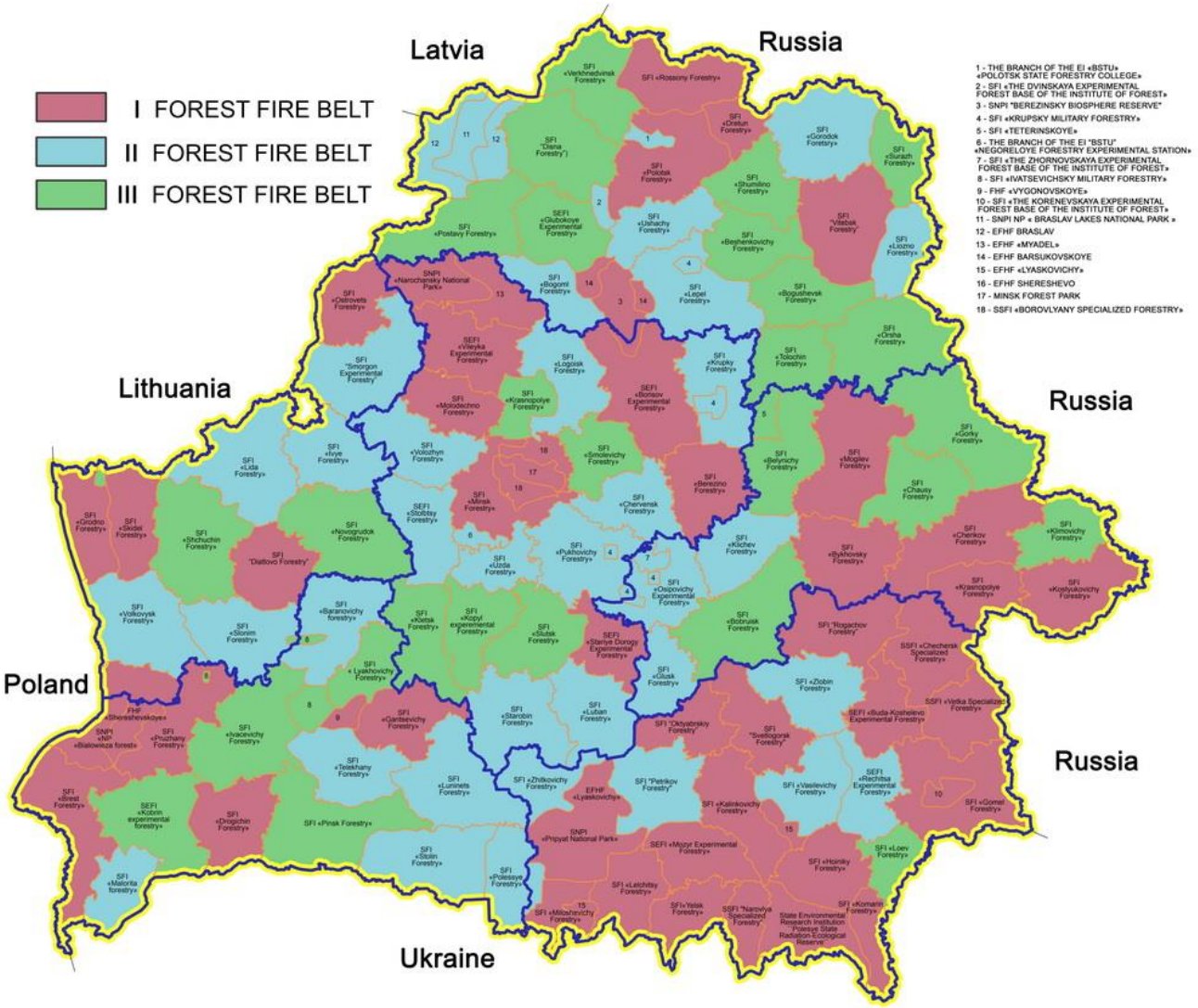

Database fires English version - Excel
State production forestry associations
Brest State Forestry Production Associations
Vitebsk State Forestry Production Associations
Gomel State Forestry Production Associations
Grodno State Forestry Production Associations
Minsk State Forestry Production Associations
Mogilev State Forestry Production Associations


Database fires English version - Excel
State forestry institutions
SFI «Baranovichy forestry»
SFI « Lyakhovichy Forestry»
SFI «Brest Forestry»
SFI «Malorita forestry»
SFI «Gantsevichy Forestry»
SFI «Pinsk Forestry»
SFI «Drogichin Forestry»
SFI «Polessye Forestry»
SFI «Ivacevichy Forestry»
SFI «Pruzhany Forestry»
SEFI «Kobrin experimental forestry»
SFI «Stolin Forestry»
SFI «Luninets Forestry»
SFI «Telekhany Forestry»


Database fires English version - Excel
Years fires
2003
2007
2012
2004
2008
2011
2005
2009
2014
2006
2010
2015
Готово

ANNEX B

Updated map of firefighting zoning of the Republic of Belarus



ANNEX C

ISS 13.020.01

AMENDMENT № 1 **TCEP 193-2009 (02080)**
Rules of firefighting arrangement of forests of the Republic of Belarus

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Put into practice by the Resolution of the Ministry of Forestry of the Republic of Belarus as of April 28, 2017 No. 9

Entered in the register of the state registration as of_____2017 № ___

Date of introduction: 2017-07-01

Section 1. Paragraph II shall have the following wording:

"Provisions of the present technical code are applied by legal entities, conducting forestry".

Terminological articles 3.9, 3.11, 3.12, 3.16, 3.20, 3.26, 3.33 and 3.38 shall have the following wording:

"3.9.Class of fire hazard by weather conditions: the relative assessment of the level of fire danger of forests caused by weather, in case of invariable fire features of the protected territory and a source of fire. [5].

3.11. Wildfire: The fire extending on forest lands, and also not forest lands (the ground fire) [5].

3.12. Forest fund: The forests located on lands of the forest fund and lands of other categories, and lands covered with forests, as well as the forest lands which aren't covered with forest, and not forest lands located within the borders of the forest fund lands and lands of other categories provided for forest management [1].

3.16. Wildfire elimination: Termination of the fire burning [5].

3.20. Protection of forests: Forestry actions aimed at the prevention, timely detection and suppression of wildfires, and also at the prevention and suppression of illegal felling, pollution of forests by sewage disposal of industrial, municipal and other facilities, chemical and radioactive materials, waste, waste products of farm animals (animal dung, manure, manure water, etc.), other actions that bring harm to forests, other violations of requirements of the legislation on use, prevention, protection and reproduction of forests, on environmental protection [1].

3.26. Forecasting of wildfires: Identification of probability of emergence and spread of wildfires in time and space on the basis of the analysis of the wildfires data [5].

3.33. Intermediate forest fellings: Cleanings, weedings and thinnings that are carried out for formation of highly productive forest plantations, prevention of wood losses and periodic subtraction of wood and shrubby vegetation hampering the growth of trees of the main breed from the forest plantations [1].

3.38. Fire suppression: Process of influence of forces and means, use of methods and techniques aimed at fire suppression [5].

Terminological articles 3.4, 3.6 и 3.22 shall be excluded.

Point 4.1. The words "standard and legal acts" shall be replaced with the words "regulations and technical regulations of the Republic of Belarus".

Point 4.3. The words "under the methodical management, control and with direct participation of the specialized services created by the Ministry of Forestry of the Republic of Belarus (hereinafter - the MoF) at the republican and territorial levels" shall be excluded.

Point 4.4. shall have the following wording:

"**4.4.** The volume of the actions that are taken for fire-prevention arrangement of the forest fund is determined by the forest management plan.

Holding the actions for fire-prevention arrangement which aren't planned by the forest management plan in cases of emergence and the need to reduce the subjects of fire-prevention arrangement in compliance with requirements of the present technical code and also during the suppression or threat of emergence of wildfire is allowed. At the same time modifications and (or) amendments to the forest management plan are not required".

Point 5.2. Paragraph six. The word "forest" shall be replaced with the words "the legislation on use, prevention, protection and reproduction of forests".

Point 7.4.1. Paragraph two. The words "intermediate fellings" shall be added with the words "behind forests".

Point 7.4.1. Paragraph four. The word "forest" shall be replaced with the word "forests".

Point 7.4.1. Paragraph five. The words "places of fellings" shall be replaced with the words "compartment".

Point 7.4.2.1. The word "forest" shall be replaced with the word "forests".

Subsection 7.5. Shall have the following wording:

«**7.5 Networks of roads of fire-prevention appointment and fire reservoirs**».

Point 7.5.1. The word "forest" shall be excluded.

Point 7.5.3. Paragraph one. The words "forest roads of economic" shall be replaced with the words "roads of forestry"

Point 7.5.3. Paragraph two shall have the following wording:

"Planning and construction of roads has to be carried out so that they could take on the role of the barriers to distribution of the possible local fires and at the same time the basic lines at their elimination. When planning construction of roads it is necessary to consider the need of the maximum use of the public roads which are available in forests".

Annex A of the technical code shall have the following wording:

Annex A

(obligatory)

Distribution of the legal entities conducting forestry on the territory of the Republic of Belarus according to forest fire belts

Table A.1

Forest fire belt	Organization

Forest fire belt	Organization
I	**Forest entities of Ministry of Forestry:** Berezinsky, Borisovsky experimental, Borovlyansky specialized, Brest, Buda-Koshelevsky experimental, Bykhovsky, Vetkovsky specialized, Vileysky experimental, Vitebsk, Gantsevichsky, Gomel, Grodno, Dretunsky, Drogichinsky, Dyatlovsky, Elsky, Kalinkovichsky, Komarinsky, Kostyukovichsky, Krasnopolsky, Lelchitsky, Miloshevichsky, Mogilev, Mazyrsky experimental, Molodechnensky, Minsk, Narovlyansky specialized, Oktyabrsky, Ostrovetsky, Polotsky, Pruzhansky, Rogachevsky, Rossonsky, Svetlogorsky, Skidelsky, Starodorozhsky experimental, Hoyniksky, Cherikovsky, Chechersky specialized. **Local executive and administrative organs:** State Unitary Enterprise "The Minsk Forest-Park Enterprise", UUPE "Grodno City Housing and Communal Services", branch CHUE "Mazyr Rayzhilkomkhoz" "Lesparkhoz", PCUE "Kommunalnik" **Ministry for Emergency Situations of the Republic of Belarus:** Polesye State Radiation-Ecological Reserve **Nature protection institutions of the Administration of the President of the Republic of Belarus:** NP "Pripyatsky", SUE "Berezinsky Biosphere Reserve", NP "Narochansky", NP "Belovezhskaya pushcha". **Experimental forest bases of the Institute of Forest of the NAS of Belarus:** Korenevskaya.
II	**Forest entities of Ministry of Forestry:** Baranovichsky, Begomlsky, Vasilevichsky, Volkovyssky, Volozhinsky, Glussky, Gorodoksky, Zhitkovichsky, Zhlobinsky, Ivyevsky, Klichevsky, Krupsky, Lepelsky, Lidsky, Lioznensky, Logoysky, Luninetsky, Lyubansky, Maloritsky, Osipovichsky experimental, Petrikovsky, Polesia, Pukhovichsky, Rechitsky experimental, Slonimsky, Smorgonsky experimental, Starobinsky, Stolbtsovsky, Stolinsky, Telekhansky, Uzdensky, Ushachsky, Chervensky. **Local executive and administrative organs:** SMUPE "Housing and communal services "Complex" **Forest entities of the Ministry of Defence:** Krupsky military. **Forest entities of the Ministry of Education:** Educationally experimental (branch EE BSTU "Polotsk State Forest College"), Negorelsky educationally experimental (EE BSTU branch). **Nature protection institutions of the Administration of the President of the Republic of Belarus:** NP "Braslau Lakes". **Experimental forest bases of the Institute of Forest of the NAS of Belarus:** Zhornovskaya. Dvinskaya.
III	**Forest entities of Ministry of Forestry:** Belynichsky, Beshenkovichsky, Babruysky, Bogushevsky, Verkhnedvinsky, Gluboksky experimental, Goretsky, Disnensky, Ivatsevichsky, Kletsky, Klimovichsky, Kobrinsky experimental, Kopylsky experimental, Loyevsky, Lyakhovichsky, Novogrudsky, Orshansky, Pinsky, Postavsky, Slutsky, Smolevichsky, Surazhsky, Tolochinsky, Chaussky, Shumilinsky, Shchuchinsky. **Forest entities of the Ministry of Defence:** Ivatsevichsky military. **Nature protection institutions of the Administration of the President of the Republic of Belarus:** SFI "Teterinskoye", SFI "Krasnoselskoye".

The structural unit “Bibliography” shall have the following wording:

[1] The forest code of the Republic of Belarus as of December 24, 2015 No. 332-Z

[2] PEFCST 1003:2010 Sustainable forest management and forest exploitation. Requirements

[3] Cross-industry regulations for labor protection in the forest, wood-working industry and in forestry

Approved by the resolution of the Ministry of Labour and social protection of the Republic of Belarus, the Ministry of Forestry of the Republic of Belarus as of 30 December, 2008 No. 211/39

[4] Rules of forest management on the territories which have undergone radioactive pollution as a result of the accident at the Chernobyl NPP

Approved by the resolution of the Ministry of Forestry of the Republic of Belarus as of 12/27/2016 No. 86

[5] Fire safety regulations in forests of the Republic of Belarus.

Approved by the resolution of the Ministry of Forestry of the Republic of Belarus as of 12/19/2016 No. 70

Executor

Director of SSI “Institute of Forest of the NAS of Belarus”	_____	A.I. Kovalevich
Task leader, head of the laboratory of problems of restoration, prevention and forest protection, doctor of agricultural sciences, professor	_____	V.V. Usenya
Principal investigator, Senior Research Scientist of the laboratory of problems of restoration, prevention and forest protection, candidate of agricultural sciences	_____	N.V. Gordey

Міністэрства лясной гаспадаркі
Рэспублікі Беларусь
(Мінлясгас)

ПАСТАНОВА

28 красавіка 2017 г. № 9
г. Мінск

Министерство лесного хозяйства
Республики Беларусь
(Минлесхоз)

ПОСТАНОВЛЕНИЕ

г. Минск

Об утверждении изменения в технический кодекс установившейся практики

В целях совершенствования нормативных технических актов по лесному хозяйству и на основании подпункта 4.6 пункта 4 Положения о Министерстве лесного хозяйства Республики Беларусь, утвержденного постановлением Совета Министров Республики Беларусь от 16 марта 2004 г. № 298 «Вопросы Министерства лесного хозяйства Республики Беларусь», Министерство лесного хозяйства Республики Беларусь ПОСТАНОВЛЯЕТ:

1. Утвердить изменение № 1 в технический кодекс установившейся практики ТКП 193-2009 (02080) «Правила противопожарного обустройства лесов Республики Беларусь» (далее – изменение № 1 в ТКП 193).

2. Ввести в действие изменение № 1 в ТКП 193 с 1 июля 2017 года.

3. Проектно-изыскательскому республиканскому унитарному предприятию «Белгипролес» (Радюкевич В.В.):

3.1. в установленном порядке зарегистрировать изменение № 1 в ТКП 193 в Государственном комитете по стандартизации Республики Беларусь и в реестре технических нормативных правовых актов Министерства лесного хозяйства Республики Беларусь;

3.2. в срок до 1 июня 2017 года обеспечить организации, подчиненные Министерству лесного хозяйства Республики Беларусь, необходимым количеством экземпляров изменения № 1 в ТКП 193.

4. Государственным производственным лесохозяйственным объединениям в срок до 15 июня 2017 года обеспечить изучение изменения № 1 в ТКП 193 ответственными работниками государственных производственных лесохозяйственных объединений и входящих в их состав государственных лесохозяйственных учреждений.

5. Контроль за исполнением настоящего постановления возложить на первого заместителя Министра лесного хозяйства Республики Беларусь Кулика А.А.

Министр М.М.Амельянович