

Forest sustainability in Belarus

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CONTENTS

1. Introduction	4
2. Belarus forests overview	4
2.1. Location and distribution	4
2.2. Ecological zones	8
2.3. Forest ownership	11
2.4. Competent authorities	11
2.5. Overview of wood-related industry	15
3. Sustainability of Belarus forest	19
3.1. Evolution of forest area and risk of conversion	19
3.2. Living wood volumes and removals	21
3.3. Protection of ecosystems and biodiversity	23
3.4. Protection of water	26
3.5. Protection of soils	27
3.6. Protection of carbon stocks	27
3.7. Protection of air quality	28
3.8. Illegal logging	29
3.9. Civil rights and traditional rights	30
3.10. Forest certification	30
4. Conclusions	31

FIGURES

Figure 1 : General map of Belarus	5
Figure 2 : Population repartition by region map	6
Figure 3 : Structure of Land area by land category	6
Figure 4 : Percent forest cover of the territory	7
Figure 5 : Forest division subject to their functions (2015)	7
Figure 6 : Location of forests affected by radiation fallout at forestry enterprises belonging to the Ministry of Forestry	8
Figure 7 : Ecological zone of Belarus	9
Figure 8 : Distribution of forest cover	9
Figure 9 : Species composition of forests	10
Figure 10 : Forestry management organization structure	12
Figure 11 : Forest industry production categories	15
Figure 12 : Production trends, imports, and exports	17
Figure 13 : Production export according to country in 2009	18
Figure 14 : Development of forest cover in Belarus since 1887	19
Figure 15 : Development of forest use in Belarus	20
Figure 16 : Reforestation and afforestation in Belarus	20
Figure 17 : Growing stock per tree specie	22
Figure 18 : Specially Protected Areas	24
Figure 19 : Number of forest fires and forest area affected by fires	29

TABLES

Table 1 : Composition of forests (2013)	10
Table 2 : Repartition of forest area among ministries and institutions	11
Table 3 : Forest and other wooded land cover between 1990 and 2015	19
Table 4 : Reforestation and afforestation between 2010 and 2016	21
Table 5 : Growing stock between 1990 and 2015	21
Table 6 : Forest felling area between 2010 and 2015	22
Table 7 : Forest loss area between 2010 and 2015	23
Table 8 : Comparison of MCPFE classes of protected and protective forest and other wooded land in Europe, forest management approaches (FMAs), and separated forest areas according to the Triad zonation approach.....	25
Table 9 : Area of forest protected, according to MCPFE Assessment Guidelines.....	26
Table 10 : Area of forest dedicated to soil, water and other ecosystem functions (MCPFE class 3) .	26
Table 11 : Carbon stock in forests (million metric tonne)	27
Table 12 : Carbon emission and removal (kt CO ₂ eq)	27
Table 13 : Forest fires.....	28

1. Introduction

The combustion of wood for energy purpose is not considered to contribute to the augmentation of greenhouse gases concentration in the atmosphere, as long as the CO₂ emissions released during the combustion of wood are balanced by the growth of new trees. It is therefore essential to investigate if the forests in the region where the wood used for energy purpose are managed in a sustainable way, avoiding resources associated with overexploitation of forests, land use change, depletion of carbon stocks, etc...

In this framework, literature research was carried out to produce a summary of forest management in Belarus, including general condition, management and sustainability assessment.

2. Belarus forests overview

2.1. Location and distribution

Belarus is a country of the eastern part of Europe that borders Lithuania on the north-west, Latvia on the north, the Russian Federation on the north and the east, Ukraine on the south and Poland on the west. The country has no connection to the sea. The country is relatively flat having its lowest place 80-90 meters above sea level and its highest point 345 meters above sea level, the hills are mainly located in the centre and the east. It has an area of 207,595 km². It has an average annual population of 9,489,600 habitants in 2016¹.

The country is divided in six regions and the city of Minsk. There is a second level subdivision called raions ("district"). The regions are represented on Figure 1. The repartition of the population among the different regions can be seen on Figure 2.

Land use in Belarus is distributed in four categories: agricultural land, forest land, land under swamps and water bodies, and other land. In 2016, forest land occupies most of the territory with 8,742,000 ha (42.1% of the total country area), agricultural land takes up to 8,582,000 ha (41.3%), land under swamps and water bodies represents 1,286,000 ha (6.2%) and other land occupies the rest with 2,150,000 ha (10.4%) (Figure 3)².

As said above, forested lands cover approximately 8,742,000 ha in 2016³. There is an entity in Belarus called the Forest Fund. The Forest Fund comprises all forests, and also lands, which are not covered by forests (forest lands and non-forest lands). It accounts for approximately 9,429,000 ha⁴.

¹ Environmental protection in the Republic of Belarus, 2016. p.18.

² Environmental protection in the Republic of Belarus, 2016. p.163.

³ FAO, 2015. Global Forest Resources Assessment 2015

⁴ Statistical yearbook of the Republic of Belarus 2016

Figure 1 : General map of Belarus

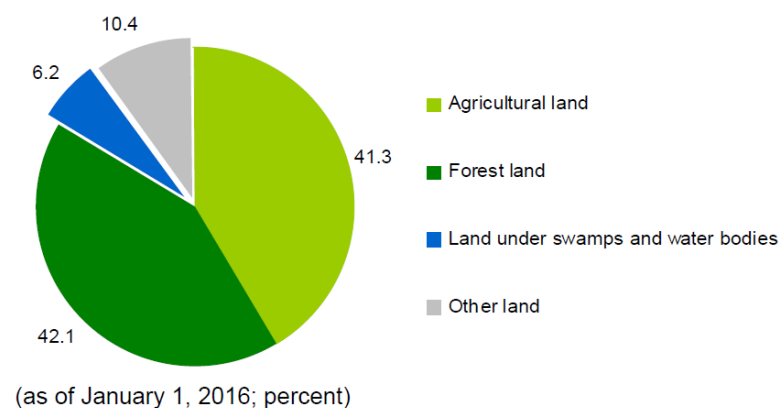


Source: Ezilon.com

Figure 2 : Population repartition by region map

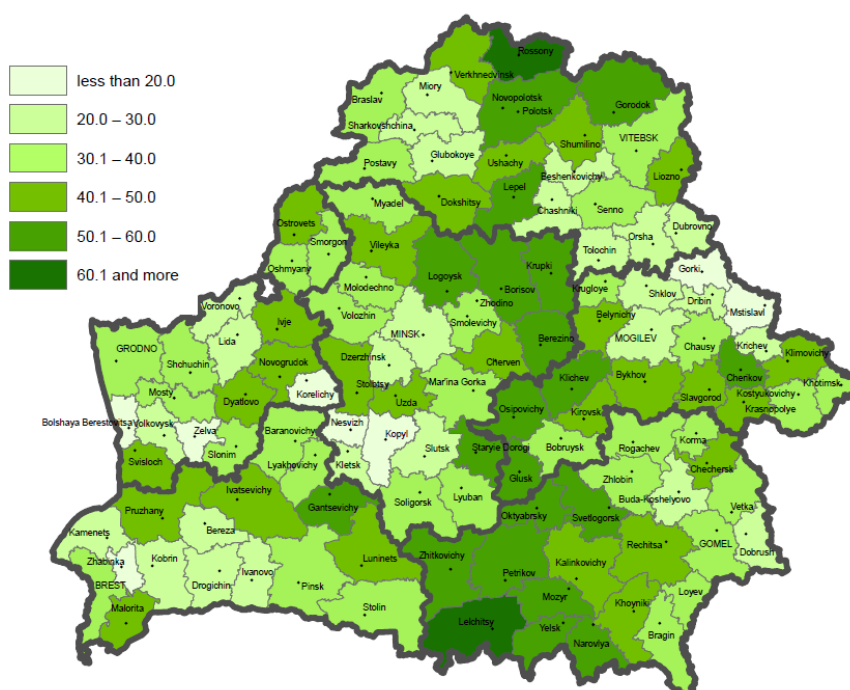
- Land area, thous. sq km
- Average annual population for 2015, thous.

Source: Environmental protection in the Republic of Belarus, 2016

Figure 3 : Structure of Land area by land category

Source : Environmental protection in the Republic of Belarus, 2016

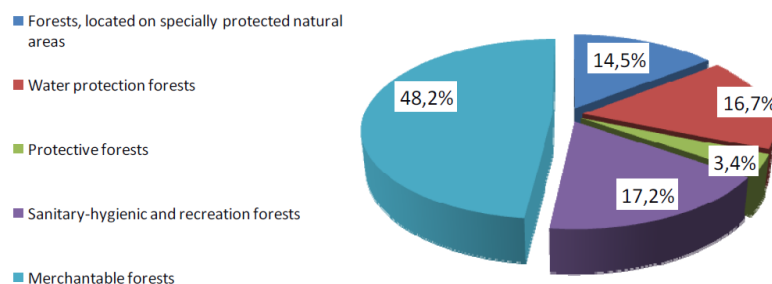
The distribution of forest land by administrative districts is presented on Figure 4. The highest density of forests follows a north to south axis in the centre of the country. The rest is unevenly distributed among the districts.

Figure 4 : Percent forest cover of the territory

Data of the State Property Committee of the Republic of Belarus.

Source : Environmental protection in the Republic of Belarus, 2016

The distribution of forest standard in the Republic of Belarus is shown on Figure 5. As 48.2% of forest are merchantable forests, 14.2% are part of the specially protected natural territories, 16.7% are for water protection, 3.4% are protective forests, 17.2% are dedicated to sanitary-hygienic and recreation⁵.

Figure 5 : Forest division subject to their functions (2015)

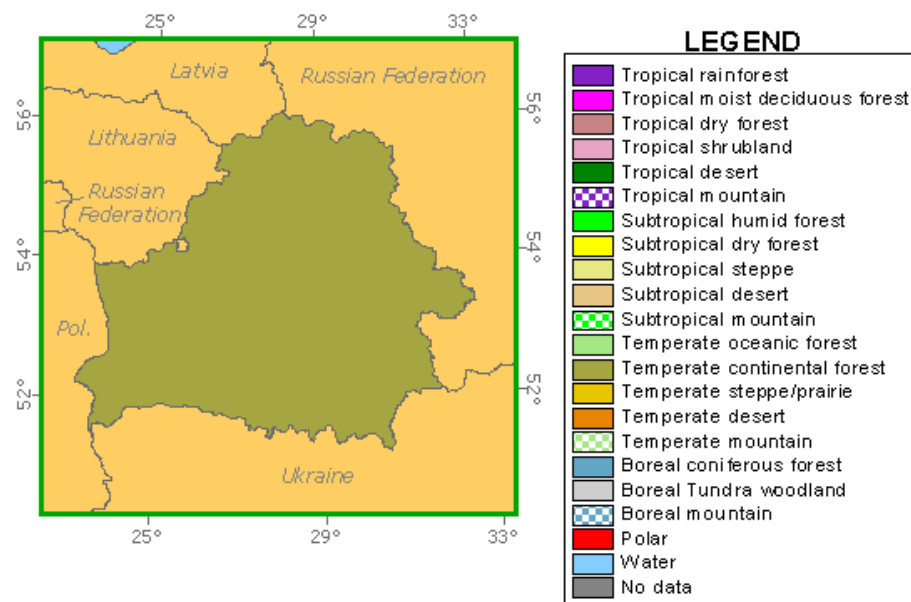
Source : Krasovsky, D., 2015. Presentation: Republic of Belarus. Implementing criteria and indicators for sustainable forest management

⁵ Krasovsky, D., 2015. Presentation: Republic of Belarus. Implementing criteria and indicators for sustainable forest management

Figure 6 : Location of forests affected by radiation fallout at forestry enterprises belonging to the Ministry of Forestry

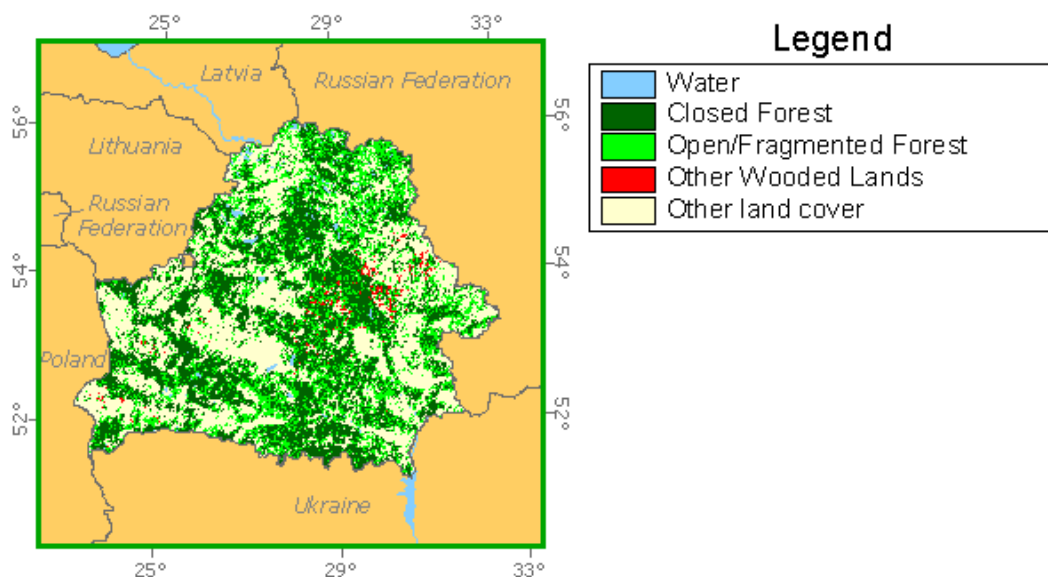


According to FAO, the entire territory of Belarus is characterized by a unique type of ecological zone: temperate continental forest zone (Figure 7). The ecological zone “temperate continental forest” has nutrient-rich bedrock that allows vegetation to grow spontaneously. The land is then well suited for forests and agriculture.

Figure 7 : Ecological zone of Belarus

Source : <http://www.fao.org/forestry/country/19971/en/>

Figure 8 presents the distribution of the forest cover on the territory. The forested areas are well distributed on the territory. Closed forests are mainly located along a North-South axis in the center of the country.

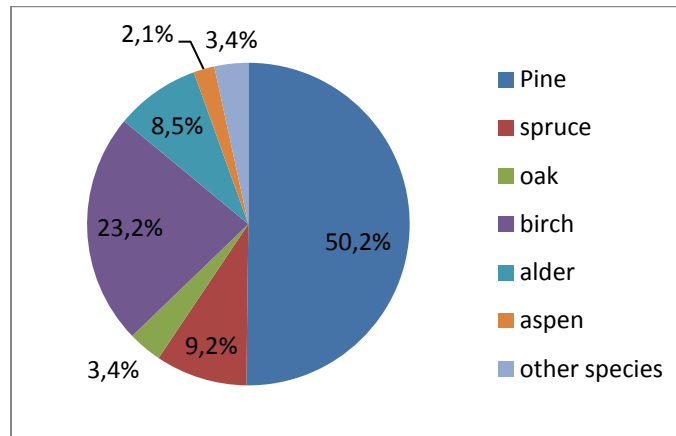
Figure 8 : Distribution of forest cover

Source : <http://www.fao.org/forestry/country/19971/en/>

Concerning the distribution of forest tree species, coniferous dominates the Belarusian forests with 5,192,748 ha (59.4% of the forests area). Hard deciduous takes up to 3,068,442 ha (35.1%) and soft deciduous occupies 480,810 ha (5.5%).

The repartition of the main tree species throughout the country is represented on Figure 9. Three species dominate the repartition: pines, birch and spruce with respectively 4,388,484 ha, 2,028,144 ha and 804,264 ha that correspond to 50.2%, 23.2% and 9.2% of the total forested area⁶.

Figure 9 : Species composition of forests



Source : Republic of Belarus. Implementing criteria and indicators for sustainable forest management

The age distribution of forests is not good from a sustainable economical development point of view. The average age of forests is about 51 years. The distribution in age is unbalanced, the young and middle age dominates all categories of forest resources. This is due to intensive harvesting after the Second World War until 1960⁷.

According to the FAO in 2013, the forests are mainly composed by naturally regenerated forest (73.23% of the forest land), planted forests (22.12% of the forest land) and in a minor way, primary forests (4.63% of the forest land) (Table 1).

Table 1 : Composition of forests (2013)

Categories	Forest area (000 ha)	% of forest land
Primary forest	400	4,63%
Other naturally regenerated forest	6323,3	73,23%
Planted forest	1910,2	22,12%
... of which of introduced species	1	0,01%
Total forest land	8634,5	100

Source : FAO, Global Forest Resources Assessment 2015

⁶ Krasovsky, D., 2015. Presentation: Republic of Belarus. Implementing criteria and indicators for sustainable forest management

⁷ Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus. Working Papers of the Finnish Forest Research Institute 170

2.3. Forest ownership

Forests in Belarus are 100% owned by the State. The Forest Fund is distributed among different ministries and institutions. The vast majority of it is managed by the Ministry of Forestry (85.5%), the President Administrative Department manages 8% while the rest is split among the other ministries and institutions (Table 2)⁸.

Table 2 : Repartition of forest area among ministries and institutions

Name of the ministries, organizations	Forest area (000 ha)	% of total area	Number of legal entities engaged in forestry management
Ministry of forestry	8103,1	85,6%	95
Ministry of Defense	89,6	0,9%	2
Ministry for Emergency Situation	216,1	2,3%	1
Ministry of Education	27,6	0,3%	2
President Administrative Department	753,7	8,0%	8
Academy of Sciences	41,4	0,4%	3
Local Authorities	38,2	0,4%	4
Joint Stock company "Vitebskdrev"	198,9	2,1%	1
Total forest land	9468,6	100,0%	116

Source : Republic of Belarus. Implementing criteria and indicators for sustainable forest management

Companies and private individuals can obtain forest rights for a certain period of time. The period of time depends on the activity. Forests can be leased from one year to 15 years for wood harvesting, it happens for some cases that the rights do not exceed one year. Usage rights can also be obtained for other activities, such as collecting non-wood forest products or hunting. These rights are obtained through auctions or by decision of the executive agency⁹.

2.4. Competent authorities

The Ministry of Forestry is the republican authority responsible for forestry matters in Belarus. It works in accordance with Forest Code adopted in 2000, and Regulations on the Ministry of Forestry approved by Decree of the Council of Ministers of the Republic of Belarus dated march 16, 2004 #298. The Ministry realizes the common state economic, scientific and technical policy in the utilization, protection, conservation of the Forest Fund and reproduction of forests in Belarus, co-ordinates activities of other state authorities concerning this field, creates normative legislative basis on forestry management, develops and realizes state programs on rational utilization, improvement of productivity and sustainability of forest, protection of their biological and landscape diversity, increase of environment making , conservation, recreational and other functions of forest.

There are 11 special organizations, these are responsible for organizational, methodological and information work, practical implementation of activities on reproduction, protection, conservation of forest and rational utilization of forest resources: "Belgoles", "Belgiproles", "Bellesexport",

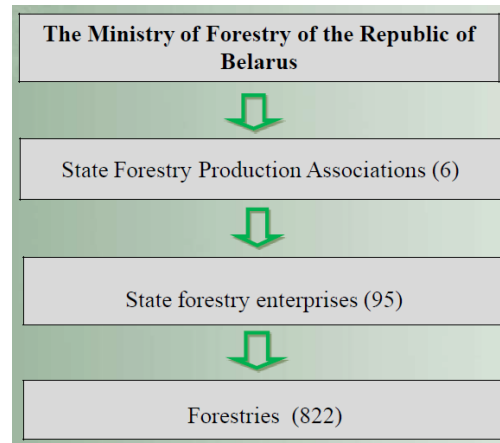
⁸ Krasovsky, D., 2015. Presentation: Republic of Belarus. Implementing criteria and indicators for sustainable forest management

⁹ Forest Code 2000

“Bellesozashchita”, “Bellesrad”, “Belgosohota”, “Ruz-Les”, Republican Forest Selection and Seed Centre, Belarus Forest newspaper, magazine “Forest and Hunting Management”¹⁰.

The State is represented at the regional level by six State Forestry Production Associations which include 95 State forestry enterprises (average area of 70 thousand ha) and 822 management units (average area is 8 thousand ha) (Figure 10).

Figure 10 : Forestry management organization structure



Source : Presentation: Forest and forestry of the Republic of Belarus

The main objectives and task of sustainable management and forest utilization in the Republic of Belarus stated in the Materials of the National Forest Certification System of the Republic of Belarus are:

Sustainable forest management and forest utilization is carried out in order:

- *to preserve forest and other resources related to the forest, their biological and landscape diversity;*
- *to strengthen ecological functions of forest;*
- *to increase economic efficiency of forestry and to meet requirements of users in forest products in Belarus and out of Belarus;*
- *to ensure social justice for workers of forestry complex and population related with forest.*

Tasks of sustainable forest management and forest utilization in the field of ecology are as follows:

- *conservation and restoration of biological and landscape diversity on the territory of forest fund;*
- *facilitation of dissemination of useful components of animal and plants world on the territory contiguous to the forest fund through introduction of appropriate systems of forest management, technological processes and methods of forestry operations and forest utilization;*
- *maintenance and strengthening of water protection role of the forest through conservation of unity and sustainability of forest cover near water basins, river sources and other water sources, at cumbines, in valleys, in flood-lands, near water supply points and other*

¹⁰ Material of the National Forest Certification System of the Republic of Belarus

- territories which are important for optimization of hydrological regime, protection against silting, guaranty of clean surface of waters;*
- *maintenance and strengthening of soil protection functions of forest through conservation of existing and creation of new plants on the lands with wind and soil erosion;*
 - *maintenance and strengthening of climate regulating role of forest through increase of their ability to binding of atmospheric carbon;*
 - *strengthening of stable impact of forest on temperature regime and regime of precipitation through conservation and increase of forest coverage, optimization of forest utilization and reduction of rejection of green-house gases into atmosphere in technological processes of forestry operations and harvesting;*
 - *support and strengthening of absorption and barrier role of forest in view of man-caused contaminations including radioactive materials;*
 - *support and strengthening of sustainability of forest ecosystems to the unfavorable impact of natural and anthropogenic origin;*
 - *compliance with ecological aspects of sustainable forest management and forest utilization in the form of effective and flexible inventory system of forest and forestry projection including forest management and operative planning of operations;*
 - *availability of effective and independent control system over compliance with ecological requirements to the forestry operations and forest utilization defined by international and national legislations, and standards of sustainable forest management and forest utilization.*
 - *maintenance of necessary level of knowledge of specialists of forestry sector in the field of ecology through system of training and re-training;*
 - *maintenance of implementation of obligations in the sphere of responsibility of forestry pursuant to global nature protection conventions [4]-[10].*

Tasks of sustainable forest management and forest utilization in the field of economy are as follows:

- *permanent forest utilization and reproduction of forest resources;*
- *prevention of reduction and exhaustion of forest resources and other useful features of forest related to this;*
- *optimization of relation of the area of production forest, forest on the specially protected nature territories and forest of other protection categories;*
- *increase of quality, customer features and competitiveness of forest products and services of forestry sector;*
- *expansion of assortment of forest products and services proposed at the internal and foreign markets by organizations of forest complex;*
- *sustainability and stable growth of economic indicators of organizations working in forestry sector;*
- *effective and independent control system over compliance with economic requirements to the forestry operations and forest utilization defined by international and national legislation, state standards of sustainable forest management and forest utilization;*
- *development of international cooperation of the Republic of Belarus in the field of forestry, utilization of forest resources, forest protection and sustainable forest management, more active participation in international economic and scientific and technical cooperation.*

Tasks of sustainable forest management and forest utilization in social sphere are as follows:

- *improvement of customer features of forest products;*

- *exclusion of unacceptable risk to life, health, inheritance of people, property and environment in the process of production, exploitation (utilization), storage, transportation, realization and utilization of forest products;*
- *guaranty to the forest workers that their labor rights and defined social privileges will be met; guaranty of safe conditions and appropriate salary, possibility of professional growth through system of training and re-training;*
- *immediate satisfaction of needs of workers of forest complex including retired pensioners, invalids, family members of the workers, if possible on advantage basis, in goods and services provided by organizations working in forestry sector and with forest utilization;*
- *satisfaction of needs of local population, training institutions, institutions of health sector and social enterprises in forest products within the frames defined by legislation of the Republic of Belarus and decisions of local authorities;*
- *maximum satisfaction of needs of branches of economy of the Republic of Belarus in forest products, including industrial enterprises, agricultural enterprises and other situated in the zone of activity of forest organizations;*
- *conservation and increase of employment level of local population in forest complex in order to improve livelihood of population and to support social stability;*
- *increase of efficiency of organizations of forest complex and their role on economy of administrative districts, on the territories of which they are situated;*
- *strengthening of economic independence and social stability of forest complex;*
- *maintenance of effective and stable control system over compliance with social requirements to the forestry operations defined by international and national legislations, this standard, and standards on sustainable forest management and forest utilization.*
- *Implementation of international obligations of the Republic of Belarus in the field of workers rights.*

100% of the forest area is under a management plan. All Forest Fund territories are covered by the basic forest inventory with the 10-year rotation, and they are the subject for the elaboration of the forest management plan for the 10-year period. The National Correspondent opinion certifies that there should not be any significant changes in the structure of the main designated functions of forests in Belarus in the nearest years. This structure corresponds to the objectives and targets of the forest management¹¹.

¹¹ FAO, 2015. Global Forest Resources Assessment 2015.

2.5. Overview of wood-related industry

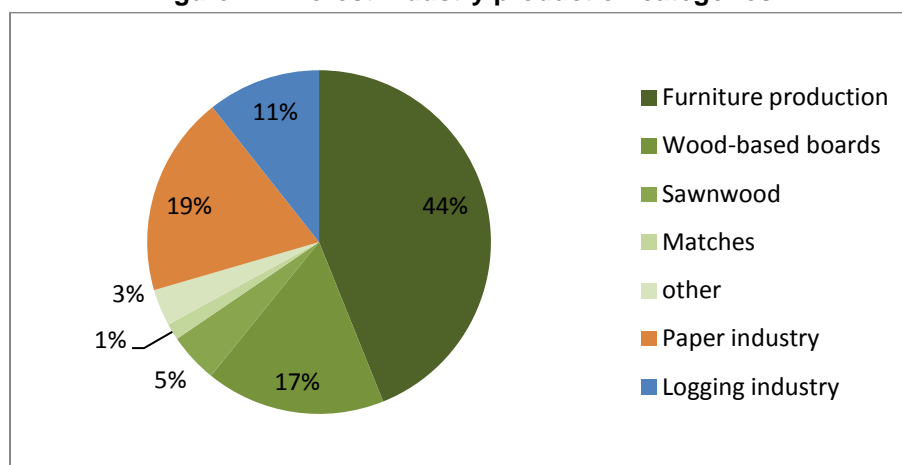
About 80% of the Belarusian forest industry remains state-controlled, the other 19% consists in non-governmental companies allowed by the State; organized in a group called Bellesbumprom, which produces 4 million m³ of forest products in Belarus. According to the forecasts, the volume of timber consumption will exceed 7.8 million m³ by 2017¹².

According to the Ministerial Conference on the Protection of Forests in Europe (MCPFE), the sector of the wood-related industry contributes to 2.7% of the Gross Domestic Product in 2010. With a total GDP of around 39 billion euro, the forest industry accounts for approximately 1 billion euro¹³.

For the year 2010, the allowable harvesting volume in Belarus was about 16.3 million m³ per year¹⁴. About 81 to 96% of it is utilized. The annual harvesting volume was approximately 14 million m³. This number has been stable over the last years¹⁵.

In its structure, the mechanical woodworking dominates the forest industry production (69.5%), followed by the pulp and paper industry (18.6%), the logging industry contributes 10.5%. Mechanical woodworking is sub-divided in the production of furniture (62.3%), wood-based boards (24%), sawnwood (6.6%) and matches (2.2%)¹⁶ (Figure 11).

Figure 11 : Forest industry production categories



Source : Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus.

The industrial roundwood production for the whole country approximates 7.4 million m³ for the year 2007 while its domestic consumption was around 5.6 million m³. Part of the 1.8 million m³ left is for exportation and the rest is left unused. According to the MCPFE, the volume of exported wood

¹² Presentation: Belarusian Production and Trade Concern of timber, woodworking and pulp and paper industry "BELLESBUMPROM"

¹³ FOREST EUROPE, UNECE and FAO 2011, State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe.

¹⁴ Forestry programme 2006, Forestry programme 2009, Baginsky 2004

¹⁵ Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus. Working Papers of the Finnish Forest Research Institute 170, p.14.

¹⁶ Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus. Working Papers of the Finnish Forest Research Institute 170, p.18.

stagnated between 2005 and 2010 around 1.3 million m³. Bellesbumprom and the Ministry of Forestry are the biggest consumers of their wood industry with respectively 44.5% and 11.1% of the total consumption. The official number from the Ministry of Forestry for 2015 indicates a total of 13.5 million m³ of cuttings of all kinds, which is a significant increase compared to the 2007 number.

Figure 12 shows the production, export and import volume trends per type of production (sawnwood, plywood, particle boards, fibreboards, pulp, paper and paperboards). The trends of the different productions show a decline until 1998 followed by an increase. The last few years before 2009 show different trends depending on the production, some decline from 2005-2006 (sawnwood, plywood, fiberboards, pulp), Particle boards and paper production continue to increase until 2008 and see their trend changing for the last year. The recent year decrease is explained by the economic crisis. However, the first half of 2010 sees the production increasing by 7% for sawnwood, 22% for plywood, 8% for particle boards, 10% for fiberboards, 67% for paper and 12% for paperboards compared to the first half of 2009¹⁷.

Belarus is more of an exporter as the half of the sawnwood and particle boards, the majority of the plywood production and one third of the paper and paperboards are exported. The products are exported to more than 20 countries represented on Figure 13 by type of production. Depending on the wood products, the destination countries vary. Most of the sawnwood products are exported to Germany (32% of the export production), Belgium (24%), Lithuania (13%) and Netherlands (13%). The majority of plywood goes to Russia (23%), Poland (20%) and Germany (17%). Roundwood is mainly exported to Poland (69%); while most of the particle boards go to Russia (31%), Kazakhstan (21%) and Uzbekistan (25%). Both Fibreboards and Paper and paperboards export productions are mainly intended to Russia (respectively 62% and 79%)

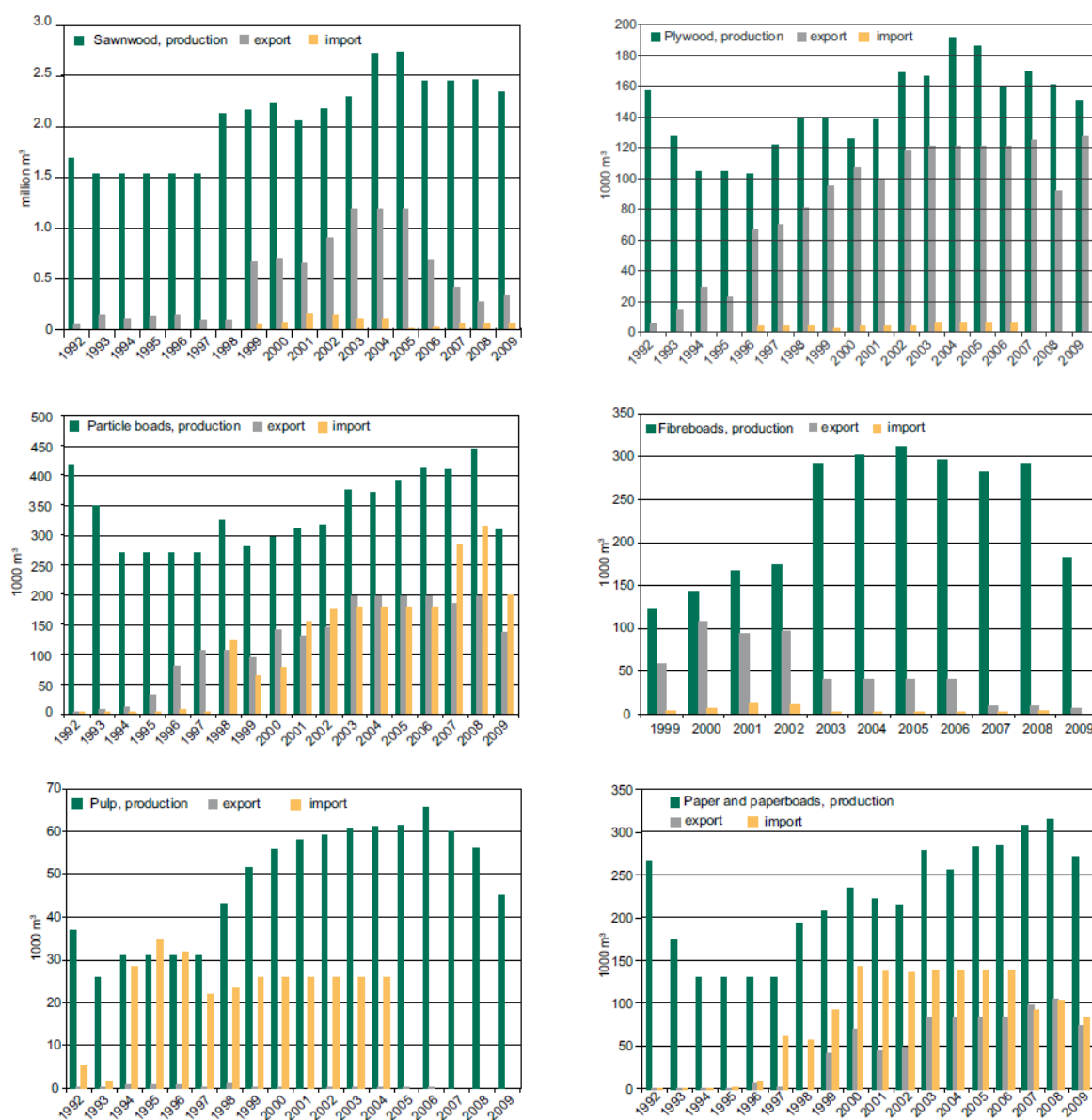
According to the MCPFE, for the period 1990 to 2010, the number of employed people has increased from 22,000 to 36,000. The percentage of male workers is 84%¹⁸.

In recent years, the forest industry has been vastly discussed by politics. It has been seen as rather undeveloped considering the vastness of the resources, the degree of processing is low, production facilities are outdated and the investments for it are minor. The objective of the government is to switch from a roundwood exporter status to a high value-added products one¹⁹.

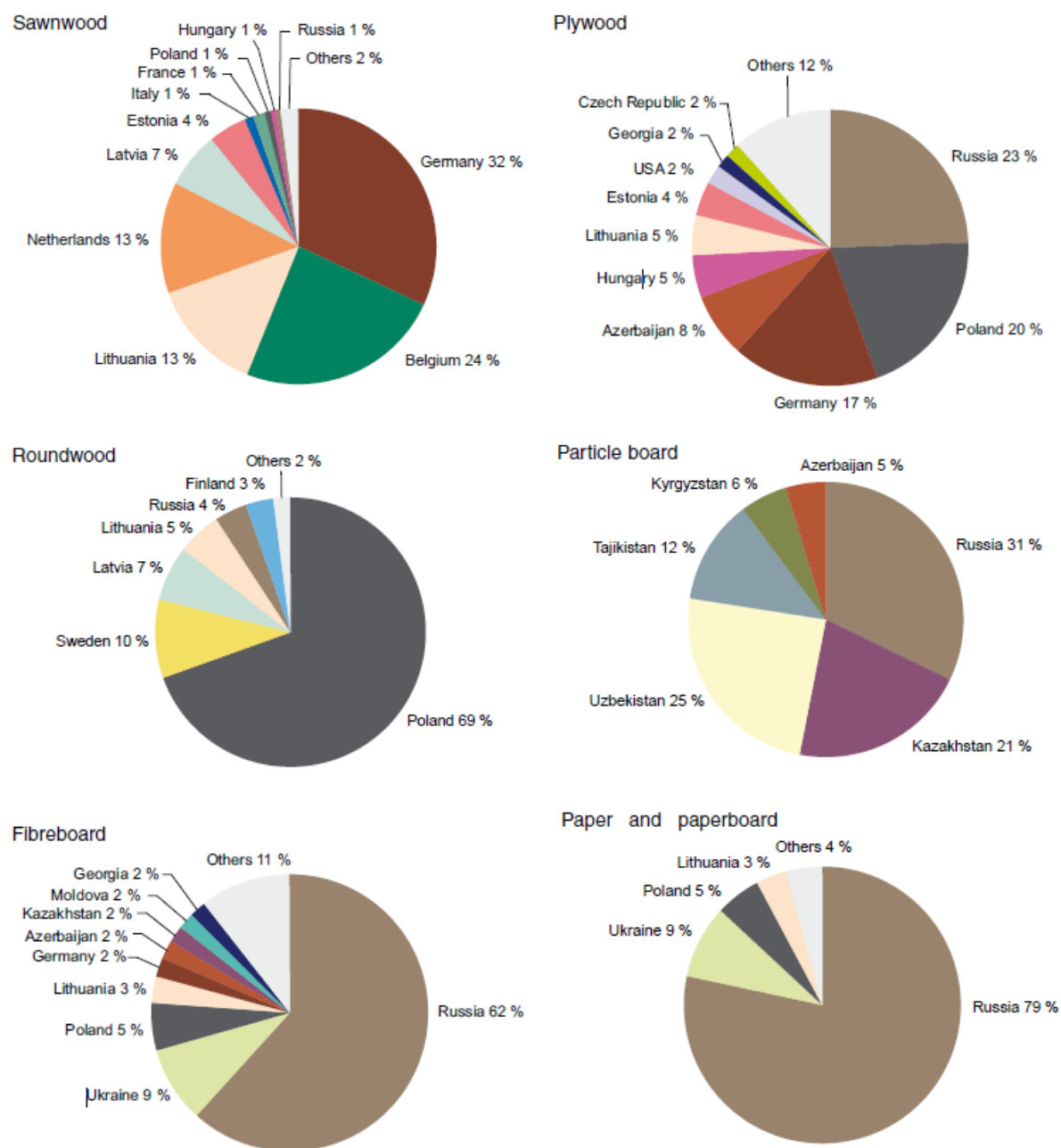
¹⁷ Belstat 2010

¹⁸ FOREST EUROPE, UNECE and FAO 2011, State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe.

¹⁹ Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus. Working Papers of the Finnish Forest Research Institute 170

Figure 12 : Production trends, imports, and exports

Source : Belstat 2010, FAOSTAT 2010

Figure 13 : Production export according to country in 2009

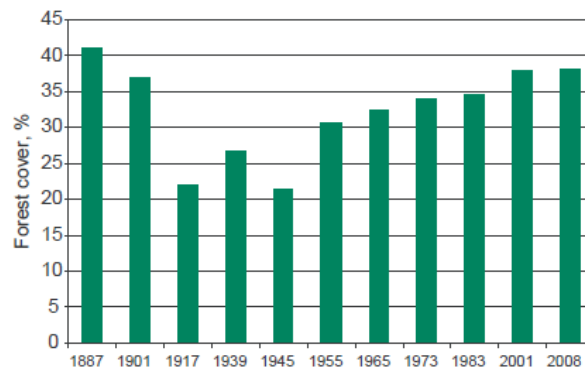
Source : Belstat 2010, FAOSTAT 2010

3. Sustainability of Belarus forest

3.1. Evolution of forest area and risk of conversion

In 1887, the forest cover in Belarus occupied more than 40% of the territory. Between 1887 and 2008, the forest cover decreased with two minima in 1917 and 1945 before increasing until 2008 and reaching 7.96 million ha (38% of the total country area) (Figure 14). In 2016, the cover reached 8,742,000 ha which consists in 42% of the country area²⁰.

Figure 14 : Development of forest cover in Belarus since 1887



Source : Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus.

According to the FAO, between 1990 and 2015 (Table 3):

- The Forest area has increased from 7.8 million ha to 8.6 million ha. The percentage of forest cover increased from approximately 37% to approximately 42%.
- Other wood lands have increased from 491 thousand ha to 539.8 thousand ha.
- The annual change decrease from 49.3 for the period 1990 to 2000, to approximately 20% for the period 2005 to 2015.
- The annual rate change decreases from 0.63% for the period 1990 to 2000, to 0.23% for the period 2010 to 2015 and seems to stabilize.

Table 3 : Forest and other wooded land cover between 1990 and 2015

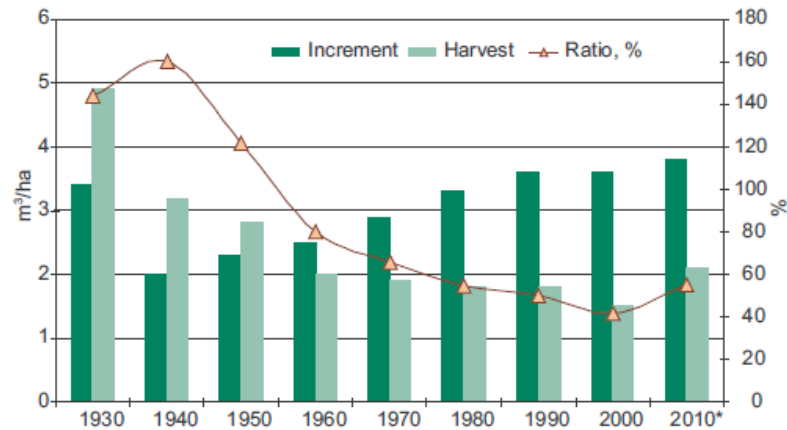
Area (000 ha)	1990	2000	2005	2010	2015
Forest	7780	8273	8436	8534	8633,5
Other wooded land	491	490	486	512,9	539,8
Total area	8271	8763	8922	9046,9	9173,3
Percentage of forested area	37,48%	39,85%	40,64%	41,11%	41,59%
Evolution of forest area (between period)	/	493	163	98	99,5
Annual change	/	49,3	32,6	19,6	19,9
Annual rate change	/	0,63%	0,39%	0,23%	0,23%

Source : FAO, Global Forest Resources Assessment 2015

²⁰ Environmental protection in the Republic of Belarus, 2016. p.163.

For the period between 1930 and 1950, wood harvesting exceeded its increment; it explains the low values of the forest cover, compared to today's values. From 1940 until 2010, the increment of forests increased. From 1960, it exceeded the harvest, explaining the increasing forest area (Figure 15).

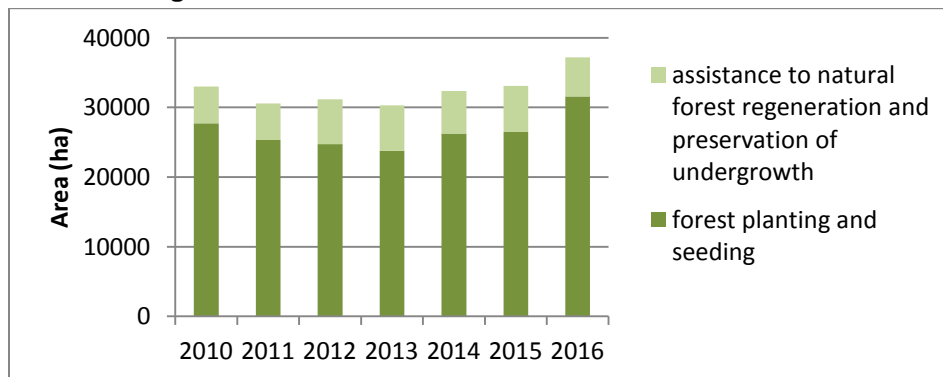
Figure 15 : Development of forest use in Belarus



Source : Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus.

The values of reforestation and afforestation in the recent years can be seen on Figure 16 and Table 4. The total reforestation and afforestation have been declining between 2010 and 2013 from an area of 32,983 ha to a surface of 31,172 ha, followed by an increase until 2016 with an area of 37,179 ha. Most of this reforestation and afforestation consists in forest planting and seeding oscillating between 80% and 84.9%. The other part consists in the assistance to natural forest regeneration and preservation of undergrowth, it ranges from 15% to 21.6%²¹. Through the data obtained by Baginsky in 1997, we note that natural regeneration prevailed between 1922 and 1945 (85%) and 1945 and 1990 (65%) due to economic difficulties. It is from 1990 that the artificial regeneration has surpassed the natural regeneration by increasing three times as much as this last²².

Figure 16 : Reforestation and afforestation in Belarus



Source : Belstat 2017

²¹ Belstat 2017

²² Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus. Working Papers of the Finnish Forest Research Institute 170. p. 17.

Table 4 : Reforestation and afforestation between 2010 and 2016

Area (ha)	2010	2011	2012	2013	2014	2015	2016
Reforestation and afforestation	32983	30555	31172	30284	32374	33094	37179
of which:							
forest planting and seeding	27695	25327	24742	23750	26247	26486	31576
assistance to natural forest regeneration and preservation of undergrowth	5288	5228	6430	6534	6127	6608	5603
Forest area biologically protected against pest and diseases	22731	22765	23673	35103	23904	22458	21640
Forest area chemically protected against pests and diseases	292	1693	664	556	356	357	1367

Source : Belstat 2017

In Belarus, it is obligatory to reforest when a process of harvesting is met. It accomplished in order to meet the attention towards ecological problems, the protection of biodiversity, gene fund and improvement of the sustainability²³.

According to the FSC risk assessment platform²⁴, Belarus is considered low risk in relation to conversion of forest to plantations or non-forest use, as there is no net loss and no significant rate of loss (> 0.5% per year) of natural forests and other naturally wooded ecosystems such as savannahs taking place in the eco-region in question.

3.2. Living wood volumes and removals

The growing stock corresponds to *“the volume over bark of all living trees with a minimum diameter of 10 cm at breast height (or above buttress if these are higher). It includes the stem from ground level up to a top diameter of 0 cm, excluding branch”*²⁵.

Table 5 presents the evolution of growing stock in Belarus between 1990 and 2015. According to the FAO, the total growing stock has increased from 1,039.2 million m³ in 1990 to 1,669.3 million m³ in 2015. The evolution is constant through the years. Both the coniferous and the deciduous trees increase. The coniferous growing stock increases from 807.8 million m³ to 1115.5 million m³, the deciduous growing stock increases from 285.4 million m³ to 553.8 million m³. The percentage of deciduous growing stock grows from 26.1% to 33.2%. The results for 2010 and 2015 were obtained by a linear interpolation²⁶.

Table 5 : Growing stock between 1990 and 2015

Category	1990	2000	2005	2010	2015
Total growing stock	1093,2	1339,2	1434,8	1580	1669,3
... of which coniferous	807,8	906,2	955,1	1061	1115,5

²³ Materials of the National Forest Certification System of the Republic of Belarus

²⁴ <http://www.globalforestregistry.org/>

²⁵ FAO, 2015. Global Forest Resources Assessment 2015, p.16.

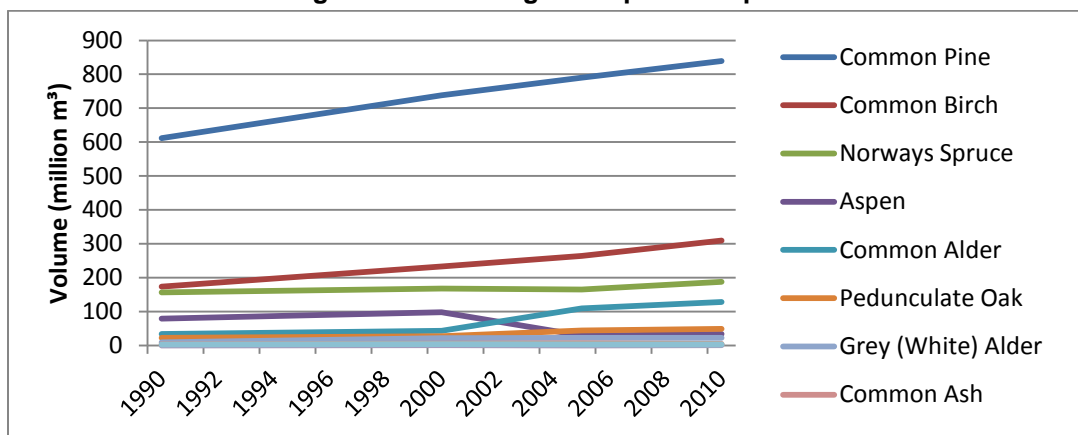
²⁶ FAO, 2015. Global Forest Resources Assessment 2015

... of which deciduous	285,4	433	479,7	519	553,8
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Source : FAO, Global Forest Resources Assessment 2015

The evolution of growing stock in Belarus from 1990 to 2015 according to the tree species can be seen on Figure 17. We note a positive change of forested volume for the main species except for Aspen. The common Pine, while dominating the other species, increases linearly from 611.1 million m³ to 838.9 million m³. The common Birch also increases constantly. The Norways Spruce seems to stagnate from 1990 to 2005 and sees its trend increasing from 2005 to 2010. The Aspen is the only specie that undergoes a big decline, while common Alder faces a major growth between 2000 and 2005. The last five categories are rather stable for the entire period, presenting a small growth.

Figure 17 : Growing stock per tree specie



Source : FAO, Global Forest Resources Assessment 2015

Table 6 shows the evolution of forest felling area between 2000 and 2015. The area increases from 415,400 ha to 578,300 ha in 2011. It is followed by a decrease to 466,900 ha in 2015. The area dedicated to final cutting grows from 20,400 ha in 2000 to 37,500 ha in 2014 and then declines to 31,300 ha in 2015. Nowadays, almost every clear felled hectare has been regenerated. A forest enterprise belonging to the Ministry of Forestry is responsible for silviculture²⁷

Table 6 : Forest felling area between 2010 and 2015

Area (000 ha)	2000	2005	2010	2011	2012	2013	2014	2015
Forest felling area	415,4	441	462,4	578,3	545	535,3	523,9	466,9
... of which final cutting	20,4	25,1	25,4	28,9	28,1	30,5	37,5	31,3
Volume (million m³)								
Marketable timber harvest by all types of cutting	10787	14109	15473	17670	18059	18521	19550	18473
... of which final cutting	4303	5213	5863	6523	6522	7143	7786	7480

Source : Statistical yearbook of the Republic of Belarus 2016

In the recent years, the evolution of the felling volume increased by 81.2%, from a volume of 10,787 thousand m³ to 19,550 thousand m³ in 2014. This volume decreases to 18,473 thousand m³ in 2015.

²⁷ Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus. Working Papers of the Finnish Forest Research Institute 170. p. 16.

The area of forest destruction categorized by the different causes can be seen on Table 7. The total area of destruction varies each year depending on its situation. 2015 is the year with the most losses compared to other years because of forest fire. 2010 faced adverse weather conditions that destroyed 11.562 ha. Forests diseases are also important. The other factors contribute less to the losses and are more stable. The forests are not permanently lost as there is reforestation.

Table 7 : Forest destruction area between 2010 and 2015

Area (ha)	2010	2011	2012	2013	2014	2015
damaged by insect pests	/	/	/	2	24	8
damaged by wild animals	323	/	2	/	2	/
forest diseases	526	708	760	541	697	985
anthropogenic factors	3	3	/	/	1	/
adverse weather conditions	11562	9345	8274	7145	7455	6446
excessive moisture	745	243	652	454	310	253
forest fires	343	269	160	79	105	5968
Total	13502	10568	9848	8221	8594	13660

Source : Environmental protection in the Republic of Belarus, 2016

3.3. Protection of ecosystems and biodiversity

The protected areas in Belarus called Specially Protected Natural Areas (SPNA) are organized as follow:

1 nature reserve

4 national parks

85 nature sanctuaries ("zakaznik") of national significance

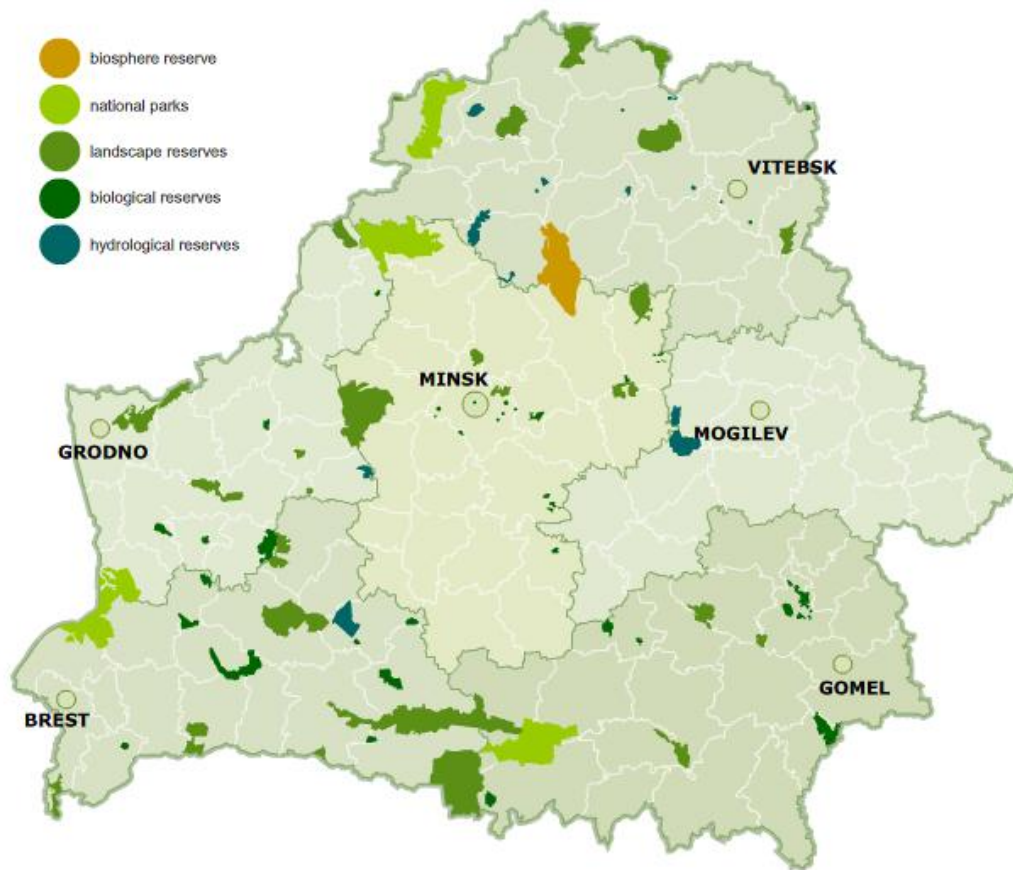
267 nature sanctuaries ("zakaznik") of local significance

306 nature monuments of national significance

568 nature monuments of local significance

The total area covered by these SPNA equals 1,811,600 ha, which corresponds to 8.8% of the total country area in 2016. The main locations can be seen on Figure 18. The repartition of the territory under protection is dominated by wildlife sanctuaries which cover 67.6% of the total protected area, national parks represent 25.3%, the only natural reserve occupies 6.2% and nature landmarks 0.8%²⁸.

²⁸ Krasovsky, D., 2015. Presentation: Republic of Belarus. Implementing criteria and indicators for sustainable forest management

Figure 18 : Specially Protected Areas

Source : http://www.minpriroda.gov.by/en/map_ohrana-en/

The nature reserve and national parks are defined by main characteristics²⁹:

- *Berezinsky Biosphere reserve: Preservation of the natural reference and other valuable natural complexes and features, study of flora and fauna, ecosystems and landscapes typical and unique of the Eastern European mixed forest, creation of conditions to ensure the conservation of natural processes. A distinctive feature of the reserve is a unique complex of forest and wetland ecosystems that almost completely preserved their natural state.*
- *Polesky State Radiation and Ecological Reserve: Restricting public access to the areas contaminated as a result of the disaster at the Chernobyl nuclear power plant, from which the population was evacuated and resettled; radiation protection, prevention of the spread of radionuclides, radiation monitoring, radio-ecological research, study of flora and fauna, typical and unique ecosystems and landscapes, natural processes characteristic of Pripyat Poles'e. The features of the reserve are the presence of high levels of environmental pollution as a result of the disaster at the Chernobyl nuclear power plant, including transuranic isotopes, restoration of the natural state of biogeocenoses as a result of removal of anthropogenic load.*

²⁹ Environmental protection in the Republic of Belarus, 2016

- *Belovezhskaya Pushcha: Preservation in the natural state and comprehensive study of the natural standard and unique features of the Bialowieza forest, biological and landscape diversity of the area, restoration of damaged natural complexes and objects of special ecological, historical, cultural and aesthetic value as well as their use for nature protection, scientific, educational and recreational purposes.*
- *Braslavskie Ozera (Braslav Lakes): Preservation of the natural complex of Braslav Lakes as a benchmark of natural landscapes, storage of genetic stock of the flora and fauna of Belarusian Lake Land and its use for nature protection, scientific, educational, tourism and recreational purposes.*
- *Pripyatsky: Preservation of the natural complex of the valley of the Pripyat river as a benchmark of natural landscapes, storage of the genetic stock of flora and fauna of Belarusian Polessye and its use for nature protection, scientific, educational, tourism and recreational purposes.*
- *Narochansky: Preservation of unique natural complexes joined by Lake Narach as reference landscapes, storage of genetic stock of the flora and fauna of Belarusian Lake Land and their more complete and efficient use nature protection, scientific, educational, tourism and recreational purposes.*

The MCPFE has defined a quantitative indicator to assess the performances of the reporting countries in terms of conservation of the forests' protective functions. The classes are precisely detailed in "MCPFE assessment guidelines for protected and protective forest and other wooded land in Europe". The classes are summarized in Table 8³⁰.

Table 8 : Comparison of MCPFE classes of protected and protective forest and other wooded land in Europe, forest management approaches (FMAs), and separated forest areas according to the Triad zonation approach

MCPFE Classes [†]		FMA	Triad zonation approach [‡]
1: Main Management Objective "Biodiversity"	1.1: "No Active Intervention"	FMA 1: Passive - Unmanaged Protected areas forest nature reserve	
	1.2: "Minimum Intervention"		
	1.3: "Conservation Through Active Management"	FMA 2: Low - Close-to-nature forestry	Multifunctional areas under ecosystem management
2: Main Management Objective "Protection of Landscapes and Specific Natural Elements"			
3: Main Management Objective "Protective Functions"		FMA 3: Medium - Combined objective forestry	
<i>No equivalent MCPFE classes are defined</i>		FMA 4: High - Intensive even-aged forestry	Intensive plantations
		FMA 5: Intensive - Short-rotation forestry	

[†] MCPFE 2003c

[‡] Seymour and Hunter 1999

Source : <https://www.ecologyandsociety.org/vol17/iss4/art51/table3.html>

The evolution of the areas in Belarus between 1990 and 2015 are presented in Table 9. For MCPFE class 1.1, we note a stable situation between 200 and 2010, followed by an increase to 165.8

³⁰ MCPFE assessment guidelines for protected and protective forest and other wooded land in Europe
<http://www.unece.org/fileadmin/DAM/timber/publications/2002-guidelines-protected-forest.pdf>

thousand ha. The area of MCPFE class 1.2 increases from 133.2 thousand ha to 163.6 thousand ha in 2015. MCPFE class 1.3 areas face an increase between 2000 and 2010, followed by a decrease to 467.9 thousand ha. MCPFE class 2 presents a variation in its areas for the whole period 1990-2015. In 2015, its area is 600 thousand ha. MCPFE class 3 faces a big increase (the double) between 1990 and 2000, from 622.2 thousand ha to 1244.5 thousand ha. It continues to increase up to 1286.8 thousand ha in 2005. It is followed by a small decrease to 1257 thousand ha in 2010. Finally, it increases again to its maximum in 2015 with 1343 thousand ha³¹.

Table 9 : Area of forest protected, according to MCPFE Assessment Guidelines

Area (000 ha)	1990	2000	2005	2010	2015
MCPFE class 1.1	/	134.8	134.8	134.8	165.8
MCPFE class 1.2	/	133.2	134	137	163.6
MCPFE class 1.3	/	443.1	497.5	511.1	467.9
MCPFE class 2	/	628	649.4	545.6	600
MCPFE class 3	642	1289.3	1328.7	1288.5	1378
... for soil, water and other forest ecosystem functions	622.2	1244.5	1286.8	1257	1343
...for infrastructure and managed natural resources	19.8	44.8	41.9	31.5	35
Total	/	2628.4	2744.4	2617	2775.3

Source : States of Europe's Forests 2015

3.4. Protection of water

The MCPFE quantitative indicator focuses on soil and water (MCPFE class 3). It is based on the surface of forest land specifically dedicated to protective functions, as defined by the following criteria³²:

- *The management is clearly directed to protect soil and its properties or water quality and quantity or other forest ecosystem functions, or to protect infrastructure and managed natural resources against natural hazards*
- *Forests and other wooded lands are explicitly designated to fulfil protective functions in management plans or other legally authorised equivalents*
- *Any operation negatively affecting soil or water or the ability to protect other ecosystem functions, or the ability to protect infrastructure and managed natural resources against natural hazards is prevented*

Table 10 : Area of forest dedicated to soil, water and other ecosystem functions (MCPFE class 3)

Area (000 ha)	1990	2000	2005	2010	2015
Land dedicated to soil, water and other forest ecosystem functions	622,2	1244,5	1286,8	1257	1343
Percentage of the forest area	8,0%	15,0%	15,3%	14,6%	15,6%

³¹ FOREST EUROPE, UNECE and FAO 2011, State of Europe's Forests 2015. Status and Trends in Sustainable Forest Management in Europe.

³² MCPFE assessment guidelines for protected and protective forest and other wooded land in Europe
<http://www.uncece.org/fileadmin/DAM/timber/publications/2002-guidelines-protected-forest.pdf>

Source : States of Europe's Forests 2011

3.5. Protection of soils

As described in the previous section, the MCPFE (Ministerial Conference on the Protection of Forests in Europe) has defined a quantitative indicator of to assess the performances of the reporting countries in terms of conservation of the forests' protective functions, especially regarding soil and water (MCPFE class 3). The conservation areas are presented on Table 10.

3.6. Protection of carbon stocks

In forest land the carbon stocks mainly includes:

- living above ground and below ground woody biomass,
- carbon in deadwood,
- carbon in litter,
- soil organic carbon.

Table 11 presents the carbon stocks in forests. The total stock in 2015 equals 1,450.3 million t of carbon. The highest contributor to this number is the living biomass, both above and below ground, with 645, million t. The soil is the second contributor with 540.4 million t and deadwood and litter are the third one with 264.4 million t. According to the expansion of the forest area and the increase of the living wood volume, the carbon stocks grow as well.

Table 11 : Carbon stock in forests (million metric tonne)

<i>Category</i>	<i>1990</i>	<i>2000</i>	<i>2005</i>	<i>2010</i>	<i>2015</i>
Carbon in above ground biomass	296	369,7	414,5	468,4	495,1
Carbon in below ground biomass	89,6	111,9	125,9	142,3	150,4
Total living biomass	385,6	481,6	540,4	610,7	645,5
Carbon in deadwood	1,9	2,7	2,9	3,1	3,3
Carbon in litter	222,6	236,7	241,3	247	261,1
Total deadwood and litter	224,5	239,4	244,2	250,1	264,4
Soil carbon	460,8	490,2	499,8	511,3	540,4
Total	1070,9	1211,2	1284,4	1372,1	1450,3

Source : FAO, Global Forest Resources Assessment 2015

Carbon emission and removals are shown on Table 12. The land use, land use change and forestry (LULUCF) is considered as a carbon sink for Belarus. Most of this sink consists in the forest carbon sink, which is calculated from the variations in carbon stocks and the emissions from drained organic soils. This sink is rather stable in time. In 2013, it represents 31% of the total greenhouse gas emissions for the whole country.

Table 12 : Carbon emission and removal (kt CO₂ eq)

<i>Category</i>	<i>1990</i>	<i>2000</i>	<i>2010</i>	<i>2011</i>	<i>2012</i>	<i>2013</i>
Total GHG emission including indirect CO ₂ emissions excluding LULUCF	151124,53	85997,43	98403,57	99045,61	98029,52	100262,9

Total GHG emission including indirect CO2 emissions including LULUCF	126741,15	59752,01	73357,33	76137,93	80943,96	78527,62
Carbon sink from LULUCF	-24383,38	-26245,42	-25046,24	-22907,68	-17085,6	-21735,3
Carbon sink for the forests	-30013,4	-32451,2	-31686,4	-31685,6	-31443,8	-31019,2

Source : Report on the individual review of the inventory submission of Belarus submitted in 2015 & Submission of information on the forest management reference level.

3.7. Protection of air quality

Concerning forests, the main impact on air quality relates to fire. It includes wild fire (which are unintended).

The total number of fire in Belarus varies in time but reached a maximum in 2015 (Table 13 and Figure 19). The total number of fire in 2016 was 319 and its cover was 251 ha³³. The number of forest fires in 2015 was 1218 and affected a total of 13,876 ha. The great majority of affected area (11,990 ha of the total affected area) was in the Gomel region, which is the one near the Ukrainian border³⁴.

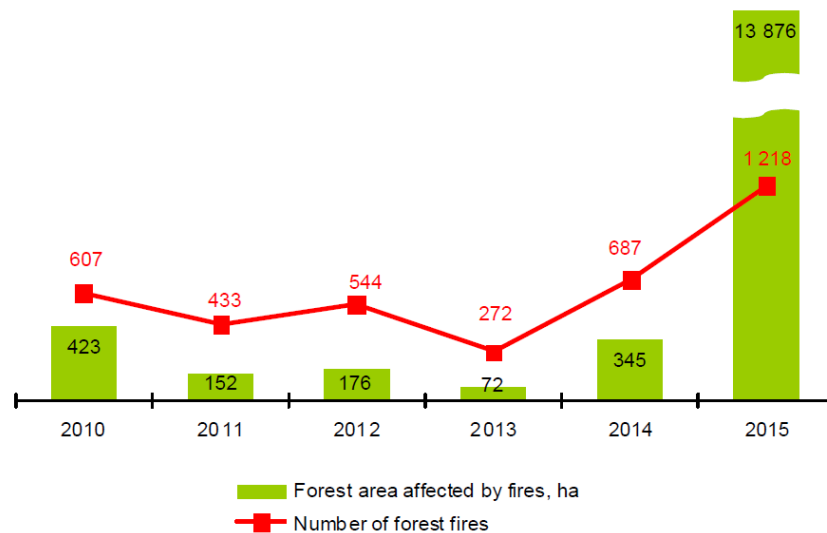
Table 13 : Forest fires

<i>Category</i>	<i>2010</i>	<i>2011</i>	<i>2012</i>	<i>2013</i>	<i>2014</i>	<i>2015</i>	<i>2016</i>
Number of forest fires	607	433	544	272	687	1218	319
Forest area affected by fires (ha)	423	152	176	72	345	13876	251
Standing timber burnt and damaged (m ³)	2165	4197	7675	1572	13735	398496	/
Forest fire control with the aid of aviation (000 ha)	9367	9364	9375	9410	9420	9461	/

³³ Belstat 2017

³⁴ Environmental protection in the Republic of Belarus, Statistical book. p.200

Source : Environmental protection in the Republic of Belarus 2016

Figure 19 : Number of forest fires and forest area affected by firesSource : http://www.minpriroda.gov.by/en/map_ohrana-en/

This massive number of forest fires raises another problem for the air. The interaction between radioactive elements from the Chernobyl disaster of 1986 and extreme fire events is analysed. According to the paper, a large amount of ^{137}Cs remains in the forests near the Ukrainian border (Figure 6). Litter carbon has doubled in the area as the tree mortality has increased and the decomposition rates have decreased, this provides fuel for wildfires increasing the chance of extreme fire events. Fires could create cloud charged with the radioactive element could rise and move over the area contaminating other regions³⁵.

The totality of the Forest Fund area is considered under forest fire control. A network of means of visual observation of the forest has been developed for the discovery of forest fires. A closed system of electronic document flow is used for the exchange of information on fire danger and fires. For operative organization of work in extinguishing of forest fires and for other production goals, a system of emergence and technical radio connection in the sector has been set up³⁶.

3.8. *Illegal logging*

According to the WWF, illegal logging is proven but the scale is unknown. The suspected quantity of wood is estimated to 1.5 million m³ (it is based on the imported wood-based products in the European Union). The repartition of the imported products is estimated to 36% of roundwood, 30% of

³⁵ Evangeliou, N., Balkanski, Y., Cozic, A., Hao, W. M., Mouillot, F., Thonicke, K., Paugam, R., Zibtsev, S., Mousseau, T. A., Wang, R., Poulter, B., Petkov, A., Yue, C., Cadule, P., Koffi, B., Kaiser, J. W. and Møller, A. P. (2015), Fire evolution in the radioactive forests of Ukraine and Belarus: future risks for the population and the environment. Ecological Monographs, 85: 49–72. doi:10.1890/14-1227.1

³⁶ Material of the National Forest Certification System of the Republic of Belarus

sawnwood and 18% of finished wood products, especially flat plates. The main costumers in the European Union seem to be Poland (29%), Germany (22%), Lithuania (14%) and Latvia (13%)³⁷.

The FSC risk assessment platform www.globalforestregistry.org confirms the lack of information concerning illegal logging and thus cannot consider Belarus as low risk concerning illegal harvesting.

According to the World Bank, in the recent years, Belarus managed to boost preventive activities against illegal logging³⁸.

3.9. Civil rights and traditional rights

The FSC risk assessment platform www.globalforestregistry.org considers Belarus as at low risk in terms of violation of civil and traditional rights, because the following criteria are all verified:

- There is no UN Security Council ban on timber exports from the country concerned
- The country or district is not designated a source of conflict timber (e.g. USAID Type 1 conflict)
- There is no evidence of child labor or violation of ILO Fundamental Principles and Rights at work taking place in forest areas in the district concerned

3.10. Forest certification

Forest certification is achieved by the Ministry of Forestry. Its purpose is to secure production and sustainability of stands, to increase forest biodiversity, to minimize negative impact, to increase export potential and to take down technical barriers in international trade³⁹.

In 1999, the decision to establish a forest certification was already accepted and in 2000, national regulations on forest certification were approved⁴⁰.

The main forest certification schemes used in Belarus are:

- PEFC (Programme for the Endorsement of Forest Certification), a global certification system that ensures sustainable forest management
- FSC (Forest Stewardship Council⁴¹), which is specifically suitable for small private owners

About 30 companies were certified with the FSC system in 2006-2007, it represents 2.5 million ha or 30% of the Forest Fund area. In 2008 20 more forest enterprises conducted a final audit of systems of forest management, and the supply chain of forest products, those represent 1.6 million ha or 19% of the Forest Fund area. This leads to 49% of the Forest Fund area certified under the FSC system⁴². In 2011, the number of certified company rises to 65⁴³.

³⁷ WWF, 2008. Illegal logging & the EU: an analysis of the EU export & import of illegal wood and related products.

³⁸ The World Bank. Belarus, Moldova, Ukraine: United by Forests

³⁹ <http://178.124.138.77/en/Certification/Certification.html>

⁴⁰ <https://www.pefc.org/news-a-media/general-sfm-news/616-belarus-achieves-pefc-recognition>

⁴¹ www.fsc.org

⁴² Gerasimov, Y. & Karjalainen, T., 2010. Atlas of the forest sector in Belarus. Working Papers of the Finnish Forest Research Institute 170. p.16

⁴³ <http://178.124.138.77/en/Certification/Certification.html>

In 2011, the Forest Certification System of the National Conformity Approval System of the Republic of Belarus is certified by PEFC concerning forestry products or their derivatives on the origin. 94 companies are certified according to the PEFC schemes⁴⁴.

4. Conclusions

Belarus forest land is estimated to cover approximately 8.742 million hectares; this represents 42.1% of the country land area. The country stands in the temperate continental forest zone. Coniferous trees are dominant in the repartition of the tree species.

The forests areas are entirely owned by the state. Their management is distributed among different ministries and institutions. The Ministry of Forestry is the main carer of the forests (85.5%). The state can give allowances to use the resources to companies and private individuals for a certain period of time. 80% of the forest industry is managed by state, while 19% consists in companies organized in a group called Bellesbumprom, which produces 4 million m³ of forest products in Belarus. According to the forecasts, the volume of timber consumption will exceed 7.8 million m³ by 2017.

According to FAO's Global Forest Resources Assessment 2015, there has been an average annual increase of the forest in percentage of the total forested area of 0.63%/year from 1990 to 2000, 0.39%/year between 2000 and 2005 and stabilizes at 0.23% from 2005 to 2015. The rate of growth decreases as the forest areas already occupy a large proportion of the territory.

Since 1990, the estimated volume of growing stock has increased to reach 1,669.3 million m³ in 2015. The total volume of felling takes up to 18,473 thousand m³ for the same year. As the reforestation and afforestation from natural and artificial regeneration exceed felling, forest volume continue to grow.

There are various types of specially protected natural areas dedicated the protection of biodiversity, soil, water. There are nature reserve and national parks, nature sanctuaries and natural monuments. All of these correspond to 8.8% of the country area. According to the Ministerial Conference on the Protection of Forests in Europe, 14.4% of the Belarusian forests are considered as having a protection status for biodiversity (MCPFE classes 1.1-1.3 and class 2) in 2010.

According to the same process, 15.16% of the forest areas were dedicated to soil, water and other ecosystem functions (MCPFE class 3).

The forests consist in carbon sink that offsets about 31% of the total greenhouse gas emissions of Belarus.

Forest fire is a cause of air pollution especially in the regions near the Ukrainian border where fire can help radioactive elements that were stocked in the forests to rise in the atmosphere.

According to the WWF, illegal logging is proven in Belarus; however its scale is unknown. The state seems to react by boosting preventive activities.

The FSC risk assessment platform www.globalforestregistry.org considers Belarus as at low risk in terms of violation of civil and traditional rights.

More than 49% of the forested area is under the FSC certification. 94 companies works according the PEFC schemes certification.

⁴⁴ <http://178.124.138.77/en/Certification/Certification.html>

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