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THE ANALYSIS OF THE DYNAMICS OF FOREST LAND FUND AND CURRENT CONDITION OF LITHUANIAN FOREST

The article reveals official statistics of the Lithuanian forest sector in 1938-2016 years and trends of the last few decades. For a better research the main trends of the dynamics of forest land fund and current condition of Lithuanian forest there are some figures and tables, which demonstrate updated forest data. Also a comparison evaluation, based on the Environmental Performance Index (EPI), between Ukrainian and Lithuanian forestry was made. The Lithuanian land fund was analyzed in accordance with a data of the National Land Service and National Forest Inventories Assessment of Wood Availability and Use, estimated the level of forestry protection strategies and it's results, given an information about features of the division of categories of the forests lands and biodiversity of the forests. Moreover, considered a governmental strategy of the forests protection.

Keywords: Lithuanian Forestry, forest land, forest coverage, growing stock volume.

Introduction. Every two years the researchers of Yale University (USA) announce the Environmental Performance Index (EPI) for the countries around the world. This index ranks countries' performance on high-priority environmental issues in two areas: protection of human health and protection of ecosystems. According to the Forest Protection Assessment in 2012, Lithuania was recognized as the country, which puts the biggest amount of effort to protect forests comparing to other countries in the world. Taking a look at general statistics, the country takes 17th place [7]. It is worth to follow a positive dynamic of the country's performance and compare it to the actions regarding the forest protection of Ukraine (Fig. 1). In this case, being able to learn a Lithuanian strategy of growing, protecting, and marketing Ukrainian forests may help the country's foresters to improve their performance and to achieve higher results.

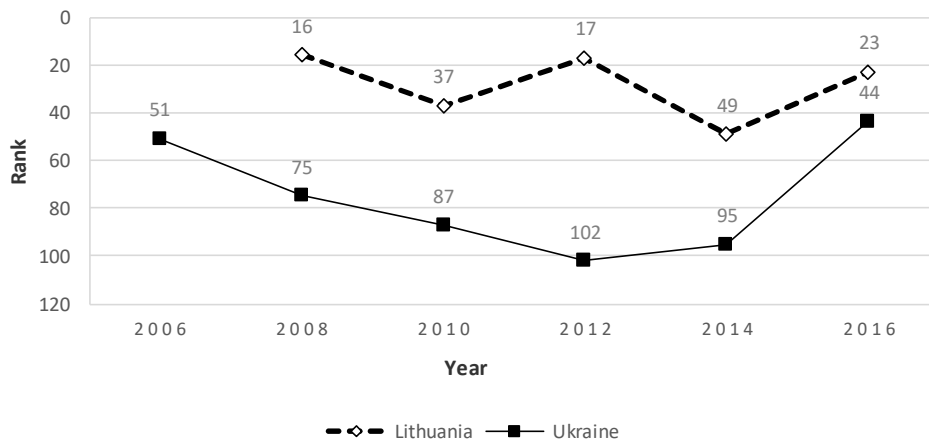


Fig. 1. The comparative rating of Lithuania and Ukraine according to Environmental Performance Index

The aim of the study. The study aims to understand a foreign experience of forestry and learn the features of the climate of Lithuania. In addition, it will also reveal geographical features, amount of species, and volume of tree felling. The study also aims to improve an understanding of forestry with a help of statistical information and to com-

pare a process of forestry in Ukraine and Lithuania. Finally, the study will reveal the key strategies, which should be applied to the forestry of Ukraine.

1.1. Characteristics of Lithuanian Forestry. Lithuania is a country, which is located in the northern part of Europe with the total area nearly 65,300 km². The country is one of the three Baltic states and is situated along the southeastern shore of the Baltic Sea. Lithuania is glacially flat, except for morainic hills in the western uplands and eastern highlands, which are not higher than 300 meters. The country has numerous small lakes and swamps; a mixed forest zone covers over 33 % of the country. The growing season of Lithuania lasts 169 days in the east and 202 days in the west and involves mostly sandy- or clay-loam soils [3]. There are 42 forest enterprises in Lithuania, which are managed by the Directorate General (General Directorate) of State Forests under the Ministry of Environment. Enhancing ecological, economic, environmental, recreational, and other socially important values of the state forest and balancing forest sector by rationally using and increasing forest resources are not the only objectives of the Directorate General [1].

Table 1. Land fund republic of Lithuania by land-use categories [6]

Land-use categories	01.01.2003		01.01.2011		01.01.2012	
	Area		Area		Area	
	1000 ha	%	1000 ha	%	1000 ha	%
Agricultural land	3487.4	53.4	3463.4	53.0	3465.3	53.1
Forest land	2008.5	30.8	2162.4	32.6	2162.2	32.6
Other wooded land (bushes)	80.1	1.2	84.0	1.2	86.6	1.3
Roads	131.0	2.0	132.1	2.0	131.8	2.0
Urban territory	189.2	2.9	180.5	2.8	181.5	2.8
Water	262.2	4.0	262.6	4.0	262.4	4.0
Swamps (bogs)	146.1	2.2	116.4	1.8	116.2	1.8
Other land	225.5	3.5	164.6	2.6	160.1	2.5
Total	6530.0	100.0	6530.0	100.0	6530.0	100.0

According to the data of National Forestry Inventory (NFI) [5], which presents more reliable data than Land Registry Forestry Inventory (SFI) [6], the total forest land area is 2,162,200 ha covering 32.6 % of the country's territory. It is important to mention that during the 2003-2012 years the coverage increased by 2,4 % as previously it was 30,9 % (Table 1). In the 16th century lands in Lithuania unsuitable for agricultural activities had to be afforested. It is assumed that in the 16th century forest coverage of Lithuania was about 60 %. Later this percentage indicator decreased due to different, mostly economic, reasons; in 1945 it did not reach 17 %. Yet, in the second half of the 20th century, Lithuania's forest coverage increased by 10 per cent (Fig. 2), (Table 2). On 23 May 2012 the National Forestry Sector Development Program was approved by the Government of the Republic of Lithuania, which currently tries to increase an area of forests up to 34,2 % by the year 2020.

1.2. Forestry Protection Control. All forest enterprises in Lithuania are certificated according to the strictest standard in the world – the FSC (Forest Stewardship Council) certificate. The Forest Stewardship Council is an international, non-profit, multi-stakeholder organization established in 1993 with the aim to promote a responsible management of the world's forests. The first two FSC forest management certificates were issued in 2001 to Birzai and Panevezio state forest enterprises. The FSC does this by setting standards on forest products and then if the standards are followed, the council labels them as eco-friendly. The fact that Lithuania is granted with FSC certifi-

cate, means that country's state forests are managed especially well. Moreover, this certification is not a one-time action; every five years certificates are renewed and every year an annual inspection is carried out.

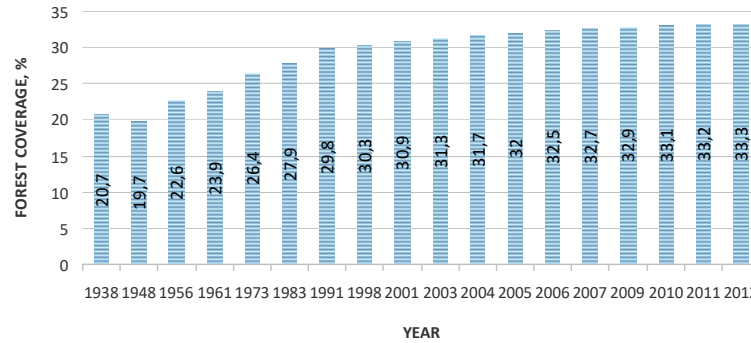


Fig. 2. Forest coverage in Lithuania, 1938-2012 [6]

Table 2. General characteristics of Lithuanian forests [5, 6]

Characteristic	01.01.2003	01.01.2011	01.01.2012
Forest land area according to Forest assessment, 1,000 ha (SFI)	2045	2170	2173
Forest area covered by stands, 1,000 ha (SFI)	1951	2057	2055
Of which planted forest, 1,000 ha (SFI)	459	508	515
Total growing stock volume, mill. m ³ (NFI)	453.4	489.8	501.3
Mean growing stock volume, m ³ /ha (NFI)	226	237	240
Total growing stock volume of mature stands, mill. m ³ (NFI)	109.9	123.9	129.1
Mean growing stock volume of mature stands of III-IV groups, m ³ /ha (NFI)	301	307	310
Gross annual increment, mill. m ³ (NFI)	16.0	16.6	17.2
Gross annual increment, m ³ /ha (NFI)	8.0	8.0	8.2
Accumulation m ³ /ha (NFI)	-	2.1	2.5
Forest coverage, % (SFI)	31.3	33.2	33.3
Forest area per capita, ha (SFI)	0.59	0.67	0.68
Growing stock volume per capita, m ³ (NFI)	131	151	157

1.3. Forest land area by land-use categories

According to the data of SFI [6], the total forest land area was 2,173,000 ha, covering 33.3% of the country's territory. Since the 1st January 2003, the forest land area has increased by 128,000 ha corresponding to 2.0% of the total forest cover. During the same period, forest stands expanded by 104,000 ha to 2,055,000 ha. Occupying 1,153,200 ha, coniferous stands prevail in Lithuania, covering 56.1% of the forest area. They are followed by softwood deciduous forests (818,500 ha, 39.8%). Hardwood deciduous forests occupy 83,800 ha (4.1%). The total area of softwood deciduous forest land increased by 120,100 ha over the last nine years. The area of hardwood deciduous has decreased by 8,800 ha and coniferous forest by 6,800 ha. The average forest area per capita increased from 0.57 ha to 0.68 ha (Table 2).

Lithuanian foresters make a hard work with not only reforestation of new areas, but also with creation new nurseries and expanding current ones (1839 ha in 2003, but 2043 ha in 2012), and developing a level of forests protection (making block and technological lines, firebreak belts and forest roads). According to the data of Table 3, the

total area of the lands for technological purposes steadily increased from 27676 ha in 2003 to 33810 ha in 2012.

The same situation with the lands for other purposes, the area of which increased in percentage from 0.3% to 0.4% during a period of 2003-2012 (Table 3). All these facts means about a stable progress, positive changes and correct management in the Lithuanian forests enterprises.

Table 3. Forest land area by land-use categories [6]

Land-use category	01.01.2003		01.01.2011		01.01.2012	
	Area		Area		Area	
	ha	%	ha	%	ha	%
Forested land	1950981	95.4	2057462	94.8	2055436	94.6
<i>natural stands</i>	1491497	72.9	1549488	71.4	1540787	70.9
<i>planted forests</i>	459484	22.5	507974	23.4	514649	23.7
Non-forested land	59521	2.9	67499	3.1	72592	3.3
<i>dead stands</i>	1523	0.1	3948	0.2	4546	0.2
<i>clear-cut areas</i>	39652	1.9	44981	2.1	49858	2.3
<i>blanks</i>	15527	0.8	13481	0.6	12855	0.6
<i>land for afforestation</i>	2819	0.1	5089	0.2	5059	0.2
<i>forest land under conversion into other categories</i>	–	–	–	–	275	0.0
Seed orchards, nurseries	1839	0.1	2102	0.1	2043	0.1
<i>seedling nurseries</i>	505		448		391	
<i>seed orchards</i>	704		829		785	
<i>nurseries</i>	630		826		867	
Land for technological purposes	27676	1.4	33938	1.6	33810	1.6
<i>block lines</i>	11860		12366		12587	
<i>technological lines</i>	667		1313		1508	
<i>firebreak belts</i>	469		468		493	
<i>routes, forest roads</i>	14680		19791		19222	
Land for other purposes	5271	0.3	8772	0.4	8975	0.4
<i>plantations of raw materials</i>	339		346		317	
<i>recreational plantations</i>	406		197		199	
<i>wood yards</i>	585		420		418	
<i>feeding places (for game)</i>	2040		3077		2890	
<i>landscape sites</i>	940		4265		4725	
<i>recreation sites</i>	960		467		425	
Total	2045287	100.0	2169722	100.0	2172855	100.0

1.4. Lithuanian Forestry Diversity. Occupying 1,153,200 ha, coniferous plants prevail in Lithuania covering 56.1 % of the forest area. Coniferous plants are followed by softwood deciduous forests (818,500 ha, 39.8 %) and hardwood deciduous forests occupy 83,800 ha (4.1 %). To be precise, scots pine (*Pinus sylvestris*) occupies the biggest share in Lithuanian forests – 722,200 ha. Norway spruce (*Picea abies*) covers 428,400 ha with a reduction of 16,900 ha. Birch (*Betula*) covers the largest area among deciduous trees. Since 2003, it has increased by 66,600 ha and reached 458,800 ha by the 1st January 2012. Areas of black alder (*Alnus glutinosa*) have increased by 22,500 ha to 141,900 ha. The area of grey alder (*Alnus incana*) has expanded by 6,500 ha. The area of aspen (*Populus tremula*) has expanded by 20,900 reaching 78,200 ha. Oak (*Quercus*) forests increased from 35,700 ha to 41,900 ha. The area of ash (*Fraxinus*) has diminished by 30 % decreasing to 35,700 ha (Fig. 3) [2, 4].

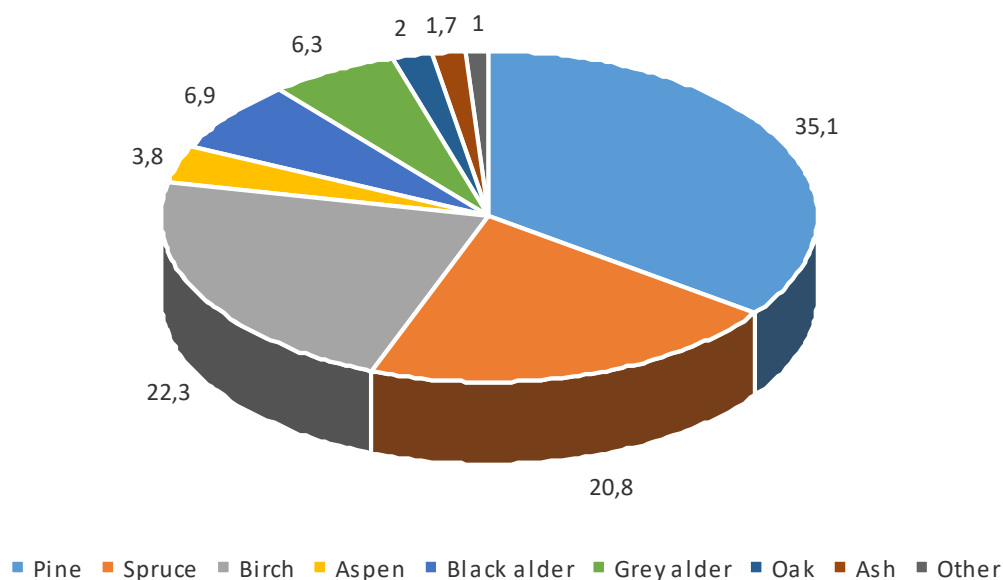


Fig. 3. Forest stands area by dominant tree species 01.01.2012 [6]

According to NFI data, since 2002 total growing stock volume has increased from 453.4 million m³ to 501.3 million m³ [5]. The average growing stock volume in all forests since 2003 has increased by 11 m³/ha up to 240 m³/ha. In the beginning of 2012, the distribution of forests by functional groups was as follows (Table 4):

- Group I (strict nature reserves): 26,300 ha (1.2 %);
- Group II (ecosystem protection and recreational): 266,800 ha (12.3 %);
- Group III (protective): 331,200 ha (15.2 %);
- Group IV (exploitable): 1,548,600 ha (71.3 %) (Table 5) .

The whole county is divided into 10 counties and 60 municipalities. The highest forest coverage was recorded in Alytus (49.1 %) and Vilnius (44.0 %) counties, while the least forested counties were Marijampole (21.7 %) and Klaipeda (26.4 %). The growing stock in Vilnius county (104.0 million m³) makes more than one fifth of the total growing stock in Lithuania [2, 4].

Table 4. Distribution of forest land area by forest groups [6]

Forest groups	01.01.2003		01.01.2011		01.01.2012	
	Area		Area		Area	
	ha	%	ha	%	ha	%
Forest reserves	23929	1.2	26264	1.2	26282	1.2
Special-purpose forests	243592	11.9	264735	12.2	266783	12.3
Protective forests	325889	15.9	330259	15.2	331201	15.2
Exploitable forests	1451877	71.0	1548515	71.4	1548589	71.3
Total	2045287	100.0	2169772	100.0	2172855	100.0

In 2011, 55,000 ha were damaged by different factors such as hunting, diseases, insects, and others. It is also important to mention that damage in previous year was up to 7 % more. The most formidable damage to the forests was caused by Spruce bud scale (*Physokermes piceae*) and Pine-tree Lappet (*Dendrolimus pini*). In addition, Green Oak Tortrix (*Tortix viridana*), Gypsy Moth (*Lymantria dispar*), Pine weevil (*Hylobius abietis*), and cockchafer (*Melolontha sp.*), are also widespread in Lithuania and usually destroy great areas every year as well [4].

Table 5. Forest stand area and growing stock volume per ha by maturity groups in III and IV group forests 01.01.2012 [1000 ha/ m³/ha] [5, 6]

Dominant tree species	Maturity groups				Total
	Young stands	Middle-aged	Premature	Mature	
Pine	100.0	390.8	52.2	47.6	590.5
	121	322	388	385	304
Spruce	203.1	72.8	39.6	75.1	390.6
	83	277	312	354	209
Birch	88.3	116.9	88.8	121.7	415.7
	38	177	287	291	199
Aspen	23.2	6.6	4.7	38.4	72.9
	42	193	262	346	245
Black alder	23.9	45.4	21.5	34.7	125.5
	34	216	275	337	219
Grey alder	9.2	12.0	28.7	58.0	107.9
	29	80	152	193	157
Oak	6.0	19.0	1.2	4.5	30.6
	63	251	-	329	220
Ash	4.7	23.6	1.3	1.3	30.9
	68	205	231	284	194
Other	2.0	3.5	1.5	3.0	10.1
	70	117	220	223	163
Total	460.4	690.6	239.4	384.1	1774.6
	73	267	288	310	236
Total 01.01.2003	407.9	665.9	312.3	308.5	1694.6
	93	242	269	301	224

1.5. Forestry Protection Strategies in Lithuania. One of the important things that Lithuanian foresters do is that they focus on and care about the way of selection; this is because they believe that this branch can open many opportunities. Therefore, it is important not only to grow big areas of forest, but it is also essential to make sure that they are of high quality ones. In this case, there are a lot of gene reserves (160) on the area of 3,631 ha, seed stands (198) on the area of 1,574 ha and 2,652 selected trees. As the result of this strategy, the main part of the harvest during 2011 was oak acorns (91,9 tons) and the general amount of collected seeds in this year reaches 93,6 tons, which is 3 times more than in 2010. Other popular species for collecting are seeds of Scots pine, spruce, silver birch, black alders, line-trees, and maple.

The area of state nurseries was 1,214 ha at the beginning of 2011. The number of forest seedlings and saplings was counted to be 132 million at the beginning of 2011. The state forest enterprises used 52,7 million plants from their own nurseries in 2011. From this, 32,1 million were planted in their own forests and the remaining 20,6 million were sold. The main share of this amount was sold to private forest owners and to other customers. State forest enterprises purchased 5,4 million plants [2, 4].

Besides the fact that Lithuanian foresters are focused and care about selection, they have also worked on two main strategies of forestry protection. Two types of forest protection, which are considered to be the most serious are forest fire protection and forest protection from illegal felling. In 2012, 81 forest fire accidents in the area of 20,29 ha and 465 cases of illegal forest felling were registered in Lithuania. Because of illegal forest felling, 1,026 m³ of wood were cut. In result, 1506 people were fined for illegal felling and other Forest Law violations. The issued penalties brought for the

country EUR 112,275. In 2012, the state forest enterprises spent 1,5 thousand EUR of their own funds on the maintenance of the general state system of anti-fire measures. While taking preventative measures, 12.5 thousand km of fire breaks were made [2, 4].

Interesting fact is that only during one year forest enterprises set up 10,200 new nesting-boxes and repaired 9,200 old nesting-boxes. In addition, 2,400 anthills were fenced and 4,400 hollow trees were marked. Influential various forest protection measures were applied by the state forest enterprises on 95,200 ha of forestland.

The amount of round wood prepared for sale was 7.3 million m³ in 2011; comparing it with 7.4 in 2010, it was considered to be very stable. The amount of round wood prepared in state forests totaled 3.96 million m³ in 2011. According to expert evaluation, the felling rate in private forests decreases by 8 % resulting in 3.3 million m³. Private forest owners received cutting permits for 2.2 million m³. Half of this (1.1 million m³) was issued to cut coniferous stands by 7 %, which in result reached 601,000 m³. Private logging companies performed 35 million EUR worth of wood harvesting and haulage works for state forest enterprises in 2011. Contractors harvested 90 % of timber procured in State forest enterprises. Half of the enterprises contracted out 100 % of harvesting works.

As the annual result of felling, there were provided 582,000 m³ of spruce, 482,000 m³ of pine, 651,000 m³ of birch, 433,000 m³ of aspen, 243,000 m³ of black alder, 41,700 m³ of ash, 47,000 m³ of alder, and only 11,900 m³ of oak.

The annual consumption of round wood in Lithuania decreased to 5.4 million m³ in 2011. Consumption of round wood in the wood industry and in the energy sector was very stable. Prices of round wood continued to increase during 2011. The most significantly (11-14 %) increased prices in State forest enterprises were performed for logs, pulpwood, and firewood [1, 2, 4].

The mean prices of round wood in state forest enterprises increased from 32 EUR/m³ in 2010 up to 40 EUR/m³ in 2011. The export of industrial round wood was 1.84 million m³, i.e. 39 % more to compare with 2010. The main foreign customers are Sweden, Poland, Germany, China, Latvia, UK, and Denmark. EU countries remained the main foreign markets for wood industry products. The total exports from Lithuania increased by 29 % in 2011 (there was a 33 % increase in 2010). Lithuania's main export markets were countries of the European Union, which is in total 61 % (61 % in 2010). Main importers are Belarus and Latvia, Poland, and Sweden. Import from Ukraine decreased from 90,000 m³ to 19,000 m³. This process mainly involved oak logs (18,000 m³) [4].

Conclusions. Lithuania has become independent at the same time with Ukraine. Yet, in fact, until 2016 our northern colleagues have made much better progress in forestry sector. Such strategies as solving environmental problems, rapid raising of forestry areas, exploitation of modern technical equipment, optimization of the process of logging, and working with civil public place Lithuania as one of the countries, which protects forestry in the most efficient way. Therefore, learning foreign experience in forestry and borrowing new technologies and approaches of Lithuanian forestry management, Ukrainian foresters will have an ability to achieve better results in their work. The first step for Ukrainian foresters would be usage of statistical information to compare the forestry management in both countries and then shaping new strategies and steps to reach the same result in the nearest future.

Secondly, the new management of Ukrainian forestry will not work unless several problems influencing the process are eliminated. Such problems are illegal logging, corruption, and old forest machines and equipment. As demonstration, Lithuania has eliminated such problems a decade ago and it has positively influenced forestry situation in long term. Finally, if Ukraine finds a way how to benchmark successful strategies from Lithuania, makes right priorities, learns how to protect and market forests, and helps to improve their performance, the country has all chances to flourish because of prosperous forestry industry in near future.

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Аналіз динаміки лісового фонду і сучасного стану лісів Литви

На основі офіційних статистичних даних щодо литовського лісового сектора впродовж 1938-2016 рр. встановлено та проаналізовано динамічні тенденції останніх десятиліть.

Для унаочнення та дослідження трендів наведено табличні та графічні дані динаміки лісового фонду та сучасного стану литовських лісів.

На основі динаміки екологічного індексу (ЕПІ) здійснено порівняльну оцінку ведення лісового господарства у Литві та на Україні. Проаналізовано земельний фонд Литви за ужитковими категоріями відповідно до даних Національної лісової інвентаризації та Земельного реєстру лісової інвентаризації, оцінено контролювання захисту лісів, наведено особливості розподілу категорій лісових земель та біорізноманіття лісів.

Крім того, розглянуто питання державної стратегії захисту лісів.

Ключові слова: лісове господарство Литви, лісовий фонд, лісистість, запаси деревини.