



## **SPATIAL AND TEMPORAL CHANGES IN SOME INDICATORS OF HUNGARIAN FOREST MANAGEMENT**

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### *Summary*

The use of forests, a versatile multi-purpose forestry sector can only be maintained through the achievement of significant quality standards required by the increased 21<sup>st</sup>-century environmental, social and economic needs. Nowadays it is a favourable condition that Hungary is a member of the European Union and, consequently, the country can apply for EU funds in the field of forest management. Unfortunately, the approximately 14 years before the accession were not without problems in this area either.

In the forest management of Hungary some economic difficulties and privatization issues have emerged since the regime change, which made it difficult slowing down the dynamic development of forest management. However, since the regime change this sector recovered within a few years and the development started, with the result that now the Hungarian forest area reached 1 935.8 thousand hectares. Nevertheless, Hungary is still one of the countries in the European Union having less favourable indicators for the forest cover. Over the past 24 years there was a growing tendency regarding forest areas. Compared to 1990, the Hungarian forest area increased by 14.2% in 2014. It is expected to keep growing in the future as well in case forestation and deforestation (forestation and felling) will be consistent and there will be no „robber management”.

If we examine the development of forests in Hungary, then we can say that there are still unexploited reserves, however it is a most welcome fact that the forest area of Hungary is growing from year to year, even if slightly. The forest-cover of Hungary was 18.2% in 2000, while in 2014 it rose up to 20.8%.

In the coming years, everything must be done to ensure that the size of the wooded area would further increase. In this field, there are large unexploited reserves, since as a member of the European Union Hungary extracted about 600-700 hectares from cultivation each year, and a significant part of these areas should be afforested again. To do so, certainly, significant resources are necessary. The benefits of this would appear not only in economic factors, but also in environmental and climatic respects.

**Key words:** forest management, forest area, forest cover, forestation, Hungary

## INTRODUCTION

Forests have an important part among the natural resources. It plays an important role in protecting the soil, the climate, and the atmosphere, in the regulation of water balance and forests ensure the living conditions for wildlife as well. This is the reason why forests have different environmental functions. For instance, shelter-belts have long been planted against wind erosion and groves, and woods to redirect wind. These forests also provide protection for plants and fauna exposed to destruction. Forests have a very significant impact on the development of micro-climate, for example temperature, air humidity, etc. through the circulation of air masses. However, their main role is in water supply watersheds and precipitation management (Komarek 2005a, 2005b, 2006, Solymos 2006).

Hungarian forests cannot be considered absolutely self-sufficient environment systems since their present form is the result of several years of human interference and management. The maintenance of the majority of forests and their services for the society in the normal standard can be achieved only through expert forest management (Komarek 2005c, 2007a, 2007c, Perczel 2003, Schiberna 2001, Solymos 2010).

During the past few decades the territory extracted from agricultural production further increased since the regime change, because of the building of settlements, the spatial demand of green field industry and other investments and because of the development of the road net and the whole infrastructure. The negative effect of this process on the quality of the environment is somewhat counter-balanced by the increase of forest areas (Komarek 2007d, 2008, Yahid et. al. 2006).

From 1945 to 1989 organised forestation was typical in Hungary. The regime change, however, resulted in an entirely new situation in Hungarian forest management as well. A part of the forests was privatized immediately after the regime change and some of it became private property, while the other part was acquired by state forest farms. Today, 60.8% of the forest land belongs to the state, 38.5% is private property and 0.7% is public ownership. Two-thirds of the

national forests is young, because the age of the trees in many cases does not even reach 20 years (Komarek 2005b, 2007, Solymos 2010).

The increase of the Hungarian forest area lags behind the optimal level accepted in long-term programmes, which is usually due to the inadequacy of financial resources. Forestation needs substantial capital, but the return on invested capital takes a relatively long time (Komarek 2006, 2007b, 2008).

## **MATERIAL AND METHODS**

The data source for the analysis, settlement data, county and national data, were provided by the Central Statistics Office (CSO). The data were used to form indicators that allowed some indicators of temporal and spatial comparative analysis and description of the main trends in the changes in the Hungarian forest management. The analysis covers the period from 2000 to 2014.

In recent years, the transformation of Hungarian agriculture induced major temporal and spatial changes in forest management as well. These changes make it necessary to carry out studies that provide answers whether there are any positive or negative changes in case of forestry, and also the weight and the role of which regions increased or decreased during the past few years. To answer these assumptions, mathematical and statistical analysis methods were used.

## **RESULTS**

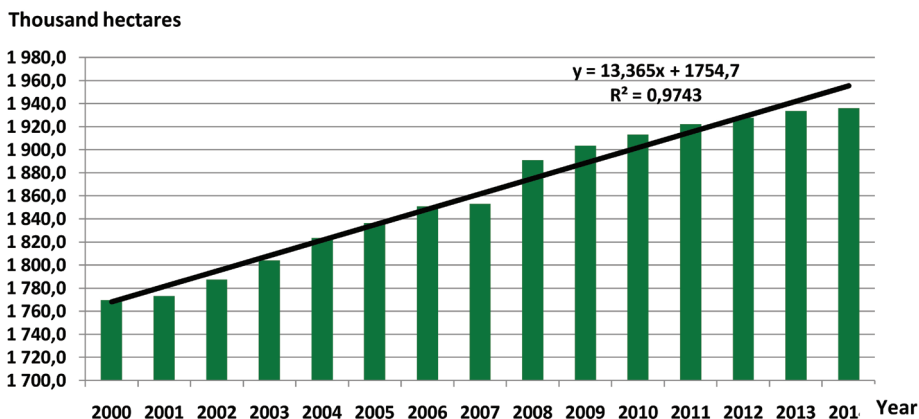
### **Forest areas and forest cover**

During the past 14 years the size of the areas used for forest management increased continuously in Hungary. In 2014 the 1935.8 thousand hectares mean a 9.4% growth, that is 166.2 thousand hectares more, compared to 2000 (Figure 1).

Forest areas are situated in a concentrated way in Hungary. Larger forests were formed mainly due to geological and climate characteristics, mostly in Northern Hungary and in the hilly regions of Southern Transdanubia. Regarding the counties, in 2000 Bács-Kiskun County had the largest forest area (169.6 thousand hectares), which was 9.6% of the national rate. Besides, significant forest areas were also in Zala County (168.8 thousand hectares – 9.5%), Borsod-Abaúj-Zemplén County (165.6 thousand hectares – 9.4%), Somogy County (162.1 thousand hectares – 9.2%) and Pest County (130.7 thousand hectares – 7.4%). The previously listed counties gave 45.1% of the total forest area of Hungary. Owing to the continuous forestation process, there was an increase in the forest area of Hungary by 2014-re compared to the base year (2000), which resulted in territorial changes on county level. That year Borsod-Abaúj-Zemplén

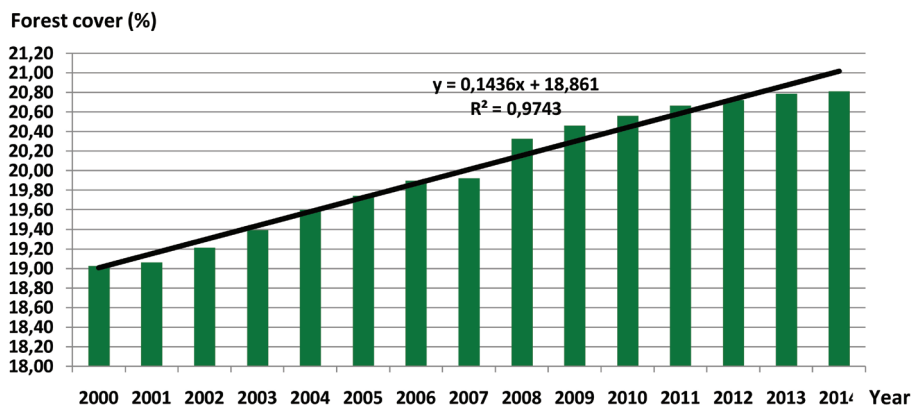
County had the largest forest area (209.1 thousand hectares – 10.8%) volt. The forest areas in Somogy County (178.8 thousand hectares – 9.2%), Bács-Kiskun County (176.6 thousand hectares – 9.1%) and Pest County (165.1 thousand hectares – 8.5%) were also outstanding.

The rate of forest cover, that is the rate of forest areas out of the total territory, is rather varied according to spatial features. In 2000 the forest cover in Hungary was 19.0%, which continuously increased during the 14 examination years and in 2014 it went up to 20.8% (Figure 2).



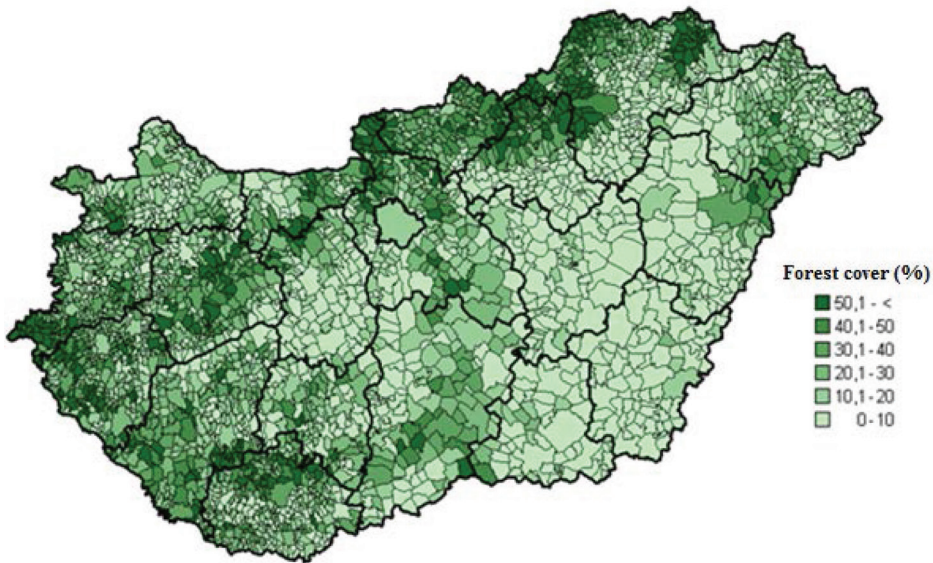
Source: Author’s calculations, based on KSH data

**Figure 1.** Forest areas in Hungary (2000-2014)



Source: Author’s calculations, based on KSH data

**Figure 2.** Forest cover in Hungary (2000-2014)



Source: Author's calculations, based on KSH data

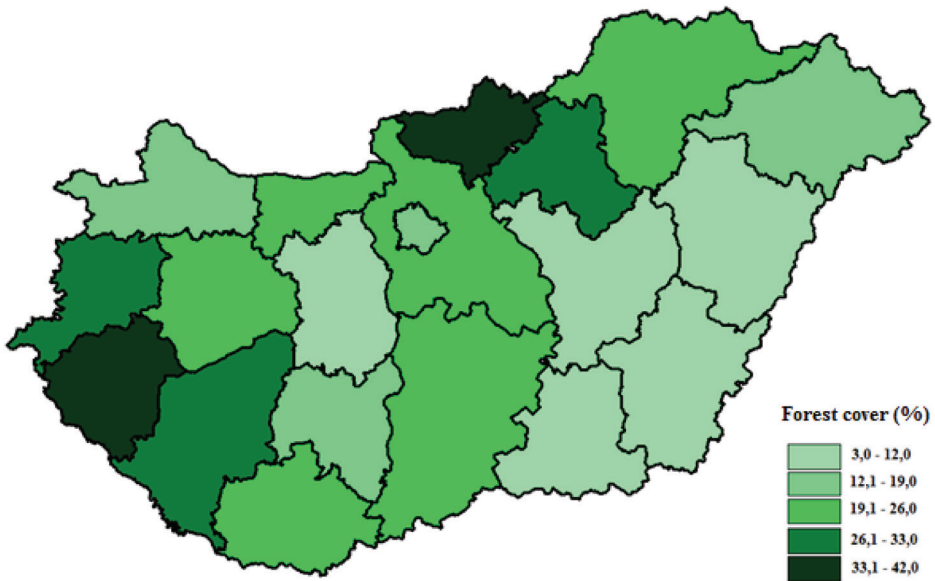
**Figure 3.** Forest cover in Hungary by settlements in 2000

The forest cover of Hungary can be analysed in a most detailed way based on the agricultural data taken in 2000. The chart describes well that the forest cover of the lowland settlements are the smallest, particularly in Békés, Csongrád and Jász-Nagykun-Szolnok Counties. There are still unexploited reserves in these areas even today. The largest forest cover can be found in the settlements of the Transdanubian and in the Northern Hills of Hungary. There are some settlements where the forest-cover well exceeds 50.0% (for instance Aggtelek, Bükkszentkereszt, Oroszlány, Dömös, Várgesztes, Bakonyszücs) (Figure 3).

Considering the regions in 2000 the smallest forest area was in Central Hungary, however the rate of the forest cover is higher than the national average (20.3%). Western Transdanubia and Northern Hungary have the largest forest areas and the rate of the forest cover there is well over the national average (19.0%), since the major part of the territory is made up of hills. The rate of the forest cover in Western Transdanubia was 28.8%, while in Northern Hungary it was 28.4%. The rate of the forest cover is the smallest in the Northern Great Plain (11.1%), where they have significant agricultural areas. Out of the counties it is in Nógrád where the rate of forest cover is outstandingly high (41.4%), and at the same time it is also significant in Zala (39.4%), Somogy (28.6%) and Heves counties (28.2%). The rate of the forest cover was the smallest in Békés County (2.3%) (Figure 4).

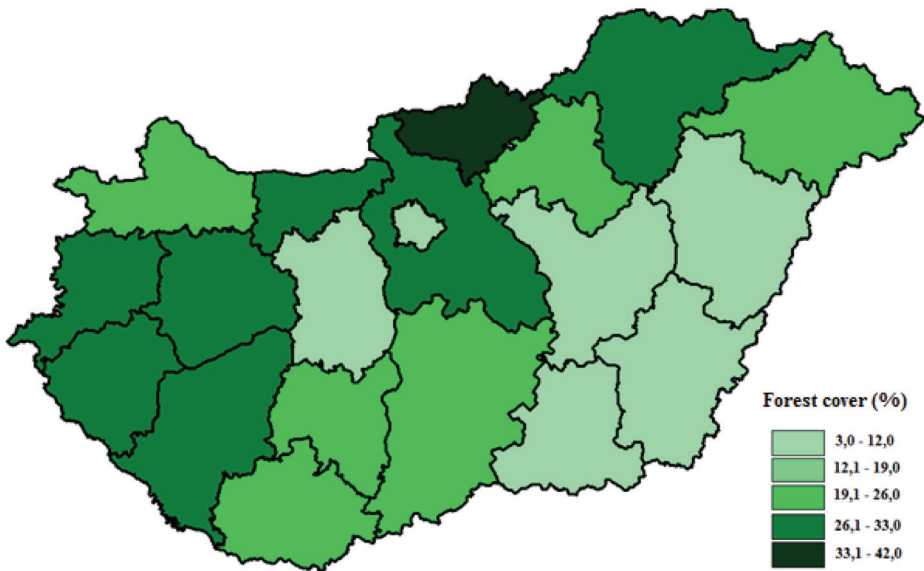
By 2014 there were no major changes in the order of forest cover of the regions. It can be said that due to the increase in forest areas the forest cover in almost every region increased from 2000 to 2014. With the exception of Western Transdanubia region, where the previous forest cover of 28.8% fell back to 26.5% primarily caused by the disruption in the balance between afforestation and felling.

Regarding the rest of the regions, the minimum forest area was still in Central Hungary, however, the rate of forest cover in the region (22.9%) is higher than the national average (20.8%). At the same time, Northern Hungary in the examination year had the largest forest areas (396.6 thousand hectares) and forest cover (30.1%). In spite of the fact that forest areas increased in the recent years, the Northern Great Plain is still among the least forested (12.4%) regions. Of the counties it is in Nógrád (32.9%) that the rate of forest cover remains much higher than the national average. In addition to Nógrád County the following counties also have values above the national average Zala (32.6%), Somogy (31.3%), Veszprém (31.1%) and Borsod-Abaúj-Zemplén (30.7%) Counties. The rate of forest cover remains one of the smallest in Békés County (4.8%) (Figure 5).



Source: Author's calculations, based on KSH data

**Figure 4.** Forest cover in Hungary by counties in 2000 (%)



Source: Author's calculations, based on KSH data

**Figure 5.** Forest cover in Hungary by counties in 2014 (%)

### The ownership structure of the forest areas

After the regime change of the ownership significantly changed and the previously co-operative-owned forests got to private owners again, and even some of the state forests were privatized in areas where the availability of land privatization fund proved insufficient. Despite the changes in the ownership structure it is still the state that has most important role. In 2014 the rate of state forest area was 55.7%, the privately owned forest area was 42.0%, the community forest area was 1.2%, while the forest area of joint ownership was 1.1%. In the past few years, these rates were almost unchanged. In contrast, the ownership structure varies significantly by counties. While in most of the counties the state forest area is the largest (Komárom-Esztergom 81.0%, Fejér 75.2%, Győr-Moson-Sopron 71.0%), in some counties on the Plains (Szabolcs-Szatmár-Bereg 71.3%, Hajdú-Bihar 51.9%, Jász-Nagykun-Szolnok 51.0%, Bács-Kiskun 50.3%) private ownership is in the major. This was resulted by the afforestation of the last 20-25 years. The rate of community-owned forest land is the highest in Békés (3.7%), and the mixed ownership forest area is in Zala (4.9%)

### Forest areas and tree stock composition by species

The extremely diverse composition of trees in Hungarian forests is mainly due to the geographical location of the country – the climatic, hydrological and soil characteristics of the Carpathian Basin. In 2000, 86.0% of the 1769.6 thousand hectares of forest area was covered with deciduous tree species, and 14.0% with conifers, while in 2014, 89.0% of the 1935.8 thousand hectares of forests area was covered with deciduous tree species, and 11.0% with conifers (Table 1).

**Table 1.** Forest areas and living tree stock by tree species

Type of Tree	2000		2014	
	Territory (%)	Living Trees (%)	Territory (%)	Living Trees (%)
Oak	21,1	25,4	20,8	23,3
Turkey oak	11,4	13,1	11,2	12,5
Beech	6,2	12,0	5,9	10,7
Hornbeam	5,9	5,5	5,2	4,7
Locust (Acacia)	21,5	12,0	24,1	13,6
Poplar	6,9	4,1	6,3	4,4
<i>Populus tremula</i>	2,9	2,4	4,2	3,9
Other deciduous	10,1	10,2	11,3	12,2
Conifer	14,0	15,3	11,0	14,7
Total	100,0	100,0	100,0	100,0

Source: Author's calculations, based on KSH data

In 2000, of the hard deciduous trees the rate of oaks covering more than 367 thousand hectares was 21.1% of the total forest area. In 2014 the oaks in the forest area covered more than 387 thousand hectares (20.8%), which means a 5.4% increase compared to the year of 2000. During the research period the increase was mainly due to Békés and Szabolcs-Szatmár-Bereg Counties. The calculations show that the oak-covered areas increased, while their share of the national forest area decreased. Thus an asymmetry was observed in the development of the forest area by tree species from 2000 to 2014, there was a shift towards for example the locust, the benefit of the *Populus tremula* and the other deciduous trees. Today, about 20.0% of the oaks are in Borsod-Abaúj-Zemplén County. The oaks are the most common species in the Northern Mountains, due to the presence of the sessile oak (*Quercus petraea*). Somogy County has a share of more than 10.0% of the oak forests of Hungary, primarily due to the pedunculated oak (*Quercus robur* L.). The distribution of oaks by age varies widely. On 12.0% of the area the tree stock is over the age of 10 years, and on 9.5% trees



older than 100 years can be found as well. Considering the national area, Somogy has the greatest share of the former ages group, while Borsod-Abaúj-Zemplén County from the latter. The living oak stock in 2000 was 82.8 thousand m<sup>3</sup>, which increased up to 85.9 thousand m<sup>3</sup> by 2014. In contrast, its rate of the national living tree stock fell back from the previous 25.4% to 23.3%.

Another important tree is the Turkey oak (*Quercus cerris*), which is the most common forest associations of Hungary, the turkey oaks is a major component of the stock together with the sessile oak. They occur in mountains and hilly areas, mostly 250-400 meters above sea level. In 2000, nearly 199 thousand hectares of forest area was covered with oak, which increased up to 208 thousand hectares by 2014. This is a 5.1% increase from the base year to the reported year. The Turkey oak took up 11.4% of the total forest area, which decreased in all counties except in Komárom-Esztergom County and Baranya County. The area of the forests occupied that area in 2000 decreased to 11.2% by 2014. It is in Veszprém County where the largest Turkey oak area can be found, which is more than 36 thousand hectares. 15.0% of the Turkey oak area is between the ages of 71 and 80. While the proportion of forests belonging to the 10-year-old or younger age group is high mostly in lowland counties (Csongrád, Békés, Hajdú-Bihar County), 18.0% of Turkey oak forests in Budapest is more than 100 years old. The Turkey oak tree stock in 2000 was 42.5 thousand m<sup>3</sup>, which grew to 46.3 thousand m<sup>3</sup> by 2014. Similarly to the oak, the rate of Turkey oak of the national tree stock decreased by 0.6% points in 2014.

Beech trees make up coherent forests in hills higher than 600 meters and also on parts of the lower but rainier territories of the Transdanubian region. Beech forests had a territory of 107 thousand hectares in Hungary in 2000, which increased over 110 thousand hectares (5.9% of the forest area) in 2014. The national increase was mainly due in Győr-Moson-Sopron and Vas Counties. 26.0% of the beech forest can be found in Borsod-Abaúj-Zemplén County (Bükk), 16.0% in Veszprém (Bakony), 14.0% of the Zala (Göcsej), and it is also present in greater proportion than 10.0% in Heves County (Mátra, Bükk). 22.0% of the beech forests is more than 100 years old, while 22.0% of them is between 81 and 100 years old. Considering the capital and the counties the youngest beech tree stock was in Somogy County (8.7%) and Budapest had the oldest stock (31.0%). The beech, a native tree species in Hungary, can be used in many ways, its wood can be formed well, and it is also significant from environmental and nature conservation point of view. The beech tree stock in 2000 was 39.1 thousand m<sup>3</sup>, which increased to 39.7 thousand m<sup>3</sup> by 2014. However, its proportion of the national living tree stock decreased from the base year to the current year by 1.3% points.

The hornbeam in 2000 had a nearly 103 thousand hectares (5.9%) share of the Hungarian forest area. By 2014 this area reduced to 96 thousand hectares (5.2%). Widespread association of hornbeam are the oak forests, which mainly

occur on hilly areas at the height of between 400-600 metres. The largest areas of hornbeam are located in Borsod-Abaúj-Zemplén (Bük, Zempléni-hills). The oak-sessile oak forests are also important areas in Baranya County (Mecsek), Zala and South Somogy in the Zselic. 14.0% of the hornbeam belong to the 71-80 age group, 2.8% are up to 10 year old, while the rate of the ones older than 100 years was 6.8%. The other age group ratios varied between 6.8 and 13.0%. 54.0% of an otherwise small hornbeam forest area of Hajdú-Bihar belonged to 1-10 year old age group. However, 22.0% of the area in Budapest was more than a 100 years old in 2014. The hornbeam stock in 2000 was 17.9 thousand m<sup>3</sup>, which fell back to 17.3 thousand m<sup>3</sup> by 2014. This is reflected in the share of national living tree stock, because from 2000 to 2014, the ratio declined by 0.8% points.

The most common tree species in the forests of the country is the acacia with short felling-rotation, which had a share of 21.5% (373.3 thousand hectares) of the total forest area in 2000. By 2014 this area increased to 450.1 thousand hectares, which means a 20.6% increase in the current year compared to the base year. The most extensive areas are in Bács-Kiskun County (60.2 hectares), however, Szabolcs-Szatmár-Bereg (56.4 hectares) and Pest Counties (47.8 hectares) also have a major locust forest area. These non-native species in our country has expanded its area in the research period, mainly due to the rich acacia forests in Szabolcs-Szatmár-Bereg County and Bács-Kiskun County. 31.0% of the acacia forests are from 11 to 20 years old, 27.0% of them belonged to the 21-30 age group, while the rate of the 1-10 year-old was 21.0%. The share of all the other age groups was a total of 21.0%. Out of the counties the highest percentage of young (not older than 10 years) acacia woods can be found in Csongrád (33.0%). The wood of this tree can be used versatile, significant as fire-wood since it burns well, even when wet, and also gives excellent honey due to the rich inflorescences. Many times this is the only species suitable for afforestation on weaker soils. The acacia tree stock in 2000 was 39.2 thousand m<sup>3</sup>, which grew to 50.1 thousand m<sup>3</sup> by 2014. The growth is reflected in the national share in the living tree stock as well, because the number increased by 1.6% points from 2000 to 2014.

56.6% (169.5 thousand hectares) of the area of the soft deciduous (265.5 hectares) was made up of poplar in 2000, whose share of the total forest area was 6.9%. By 2014 its former area of 169.5 thousand hectares increased to 195.8 thousand hectares, which means a 15.5% increase from the base year to the reporting year. The poplar (hybrid) –plantations are utilised mainly on the floodplains of the rivers, but also on other agricultural areas, as a line of trees and also as tree production plantations. Their most common occurrence is in Szabolcs-Szatmár-Bereg County and Pest County (17.0-17.0%). The poplar tree stock in 2000 was 21.0 thousand m<sup>3</sup>, which grew to 30.8 thousand m<sup>3</sup> by 2014. It is also reflected in the share from the national living tree stock as it increased by 0.3% points from the base year to the report year.

The several poplar tree species (*Populus* L.) indigenous in Hungary are mainly situated on the Plain, in the floodplain forests, the deeper parts of the sandy dune areas on the Plain, 44.0% of the poplar wood is in Bács-Kiskun County (Homokhátság-Sand Ridge). The ratio of the Hungarian poplar area in 2000 was 2.9%, which increased to 4.2% in 2014. Among the currently cultivated poplar woods there are several varieties with intensive growth and good rooting re-sprouting ability, which are suitable for energy-purpose plantations as well. The living poplar-tree stock in Hungary increased 1.5% points from the base year to the report year.

The area of other soft deciduous woods in 2000 was nearly 96 thousand hectares (10.1%), which increased up to 99 thousand hectares in 2014. 22.0% of the area was linden, 21.0% was willow and 7.3% was other soft deciduous wood. The woods mostly covered by water in summer primarily contain alder species-and also some ash-trees as well. Usually they live in the wide, flat valleys of hilly areas in Somogy County (Belső-Somogy, Zselic, Zákányi-dombság). The alder is an excellent soft wood suitable for building material in water constructions. The lime is a typical common tree in the Carpathian Basin: it often appears in oak forests, beech forests, Turkey-oak forest and floodplain forests and in rocky areas. The largest lime forests were located in Somogy, their share from all the linden area was 27.0%, while in Baranya County also had a significant linden area (22.0%). The limes give perhaps out of all tree species, the wood easiest and best to carve. Within the floodplain woods the willow and poplar – also known as soft-wood trees –are the most common accompanying groves of rivers. Today, due to the rapid growth the willow is also cultivated on energy plantations. The willow mainly occurs in Győr-Moson-Sopron (Szigetköz, Hanság) and Baranya County (10.0 and 11.0%), and the species belonging to other category are located in Somogy (41.0%). The other soft deciduous tree stock increased from 2000 to 2014 by 2.0% points.

In 2000 the conifers had a share of 243.5 thousand hectares (14.0%), from the whole wooded area of Hungary 59.0% of this was pine, 28.9% of black pine, 12.1% was other pine. By 2014 its area reduced to 204.3 thousand hectares, which means a 16.1% decline compared to the base year. Among the conifers the pine – area decreased the most (16.9%). In the case of black pine 11.1%, in the case of other pines 24.1% was the decline from 2000 to 2014. The pine is located on 143.7 thousand hectares, mainly in Western Transdanubia with the largest area in Vas County (Alps). One third of the pine forest is 31-40 years, and one-fifth is 41-50 years old. The ratio of the 10-year-old or younger woods is 1.5% (the highest proportion Vas County), but trees older than 100 years may also occur, with a share of about 0.8%.

The black pine forests had a share of 4.0% from the Hungarian forest area in 2000. By 2014 this rate decreased to 3.4%. In recent decades, the black pine was planted especially in the dry sand sandy places therefore more than half of

the area is in Bács-Kiskun County. Except Jász-Nagykun-Szolnok, in each county the black pine area is less than in the previous years.

Out of the other conifers the spruce (73.0%) is the most common species; then follows the pine (16.0%) and in the end the other species (11.0%). The spruce is a tree growing in continental climate, which needs at least 700 millimeters of precipitation per year and normally prefers cold places like such as Vas County (25.0%), Zala County (22.0%) and Borsod-Abaúj-Zemplén County (23.0%). The forest area covered with spruce not decreased by 10.0%; it fell back in all the counties where the spruce was mostly present. The redwood (larch) is a typical pine species on the mountains, and subalpine areas of the northern hemisphere. In Hungary, similarly to the spruce, redwood occurs in the higher, wetter areas, in Zala, Vas and Borsod-Abaúj-Zemplén Counties. The living pine stock in 2000 was 49.6 thousand m<sup>3</sup>, which increased up to 54.4 thousand m<sup>3</sup> in 2014, while their share of the national living tree stock fell back by 0.6% points from the base year to the report year.

**Table 2.** The schedule of forestation (ha)

Year	State Forestry Units	Other Forestry Units	All Forestry Units
2000-2001	665	12472	13137
2001-2002	755	14075	14830
2002-2003	899	11116	12015
2003-2004	437	7137	7574
2004-2005	628	7029	7657
2005-2006	770	13219	13989
2006-2007	552	18436	18948
2007-2008	391	6 941	7 332
2008-2009	791	4 377	5 168
2009-2010	1 084	4 012	5 096
2010-2011	143	2 660	2 803
2011-2012	516	4 021	4 537
2012-2013	136	2 394	2 530

Source: Author's calculations, based on KSH data

### **Afforestation**

One of the main objectives of forestry policy is to increase the forest area with afforestation to reach approximately 26-27% forest cover. In the growing season of 2000/2001 afforestation was completed, on a total area of 13.1 thousand hectares, which fell back to 2.5 thousand hectares in the 2012/2013 growing

season. From the 2006/2007 growing years the size of the completed new plantation area continuously decreased, except the period of 2011/2012. Meanwhile, there is a large proportion of area where the successful completion of the woodland is delayed for some reason. One significant reason for the delay of the plantation is the extreme weather condition. During the research period the highest rate of forest area expansion was in Bács-Kiskun County, due to the completed plantation of acacia, poplar and other soft wood species as well as pine-woods. Beech plantation was completed exclusively in Borsod-Abaúj-Zemplén County and pines were planted in five counties only (Pest, Győr-Moson-Sopron, Borsod-Abaúj-Zemplén, Bács-Kiskun and Csongrád) (Table 2).

Overall it can be concluded that owing to the forestation of the previous years the forest areas in Hungary further increased.

### **The health of the forests**

The health of the Hungarian forest are primarily influenced by the weather conditions (drought, frost, ice, wind) and some biotic pests (fungus and insects), but there is also considerable damage caused by wildlife. When assessing the health status, there are three main categories of damage – biotic, abiotic and unexplained. Their rate changed little in recent years.

The majority of the forest damage is of biotic origin; their proportion among all forms of damage is 54.8%. Within the biotic damage it is the insect damage that has the largest proportion (27.7%). This is followed by various fungal lesions (11.5%). Damage as a result of human activities (6.9%) are mainly mechanical damage and injuries caused when approaching. Lesions classified as other, also belong to the ratio of 6.5%. The wildlife damage represents 2.2%. The second most frequently occurring damage group is the unknown origin or deterioration category. Any group of symptoms, which is generated by the deterioration of trees and series of damage, were included in this category during the recordings. This group involved 33.2% of the damage. The abiotic damage together with the fire damage, which was indicated separately, however naturally belongs here, made up 12.6% of all damage.

Based on all the damage in Hungary in 2000, 34.3% of the trees were healthy, 41.4% slightly damaged, 18.9% medium and 3.0% heavily damaged. The proportion of dead trees amounted to 2.4%. In 2014, 38.8% of the trees were healthy, 33.6% slightly damaged, 20.9%, were moderately and 3.8% were in heavily damaged state. The proportion of dead trees in the report year increased by 0.5% points compared to the base year (Table 3).

Comparing the results of studies on the 2014 health data with that of the previous years we found that there was a significant deterioration in the state of health of the trees in 2014. The proportion of asymptomatic trees decreased by 16.8% compared to the data in 2013, while the proportion of endangered trees

increased by 11.6%. Similarly, the number of moderately damaged and heavily damaged trees showed smaller increases. These changes, in contrast to previous minor deterioration, should be regarded as more significant and suggest that the forest was strengthened in an unfavourable process, which led to the significant deterioration of tree health in 2014. All these negative changes occurred despite the fact that the weather was favourable during the growing season in the year of 2014. The average number of rain fell and the monthly mean temperatures were generally free from extremes. The deterioration was started by the adverse weather conditions in the previous years, and the effects accumulated spectacularly in 2014.

**Table 3.** Health status of Hungarian forests (2000-2014)

No symptoms (%)	Weak	Medium	Heavy	Dead (%)
	damage (%)			
34,3	41,4	18,9	3,0	2,4
33,9	41,8	18,9	3,0	2,4
34,3	40,6	19,5	3,1	2,5
31,5	42,0	20,3	3,6	2,6
34,8	39,0	19,6	3,8	2,8
33,2	39,6	20,0	4,1	3,1
36,8	40,5	16,9	2,9	2,9
51,8	27,5	12,5	5,9	2,3
60,7	23,2	10,8	2,5	2,8
54,8	26,8	12,4	3,3	2,6
49,3	28,9	14,7	4,4	2,7
62,3	18,9	13,7	2,1	2,9
59,5	18,4	15,4	2,5	4,1
55,6	22,0	16,5	3,0	2,8
38,8	33,6	20,9	3,8	2,9

Source: Author's calculations, based on KSH data

## CONCLUSIONS

Significant changes have occurred in the forest management in Hungary from the years following the regime change to the present.

In the year of the regime change (1990) Hungary had 1695.4 thousand hectares of forest area, which increased up to 1935.8 thousand hectares today (2014). This represented a 14.2% change between 1990 and 2014. The continu-

ous growth of the areas used for forestry resulted in a growth in the proportion of forest cover as well. In the last 24 years, the forest-cover of Hungary increased from the previous 18.2% up to 20.8%. The effect is also reflected on regional level, especially in regions where forest management still has unutilised reserves (e.g. in counties on the Plain). The completed forest plantations played an important role in the development of forest areas and the increase in forest cover in recent years.

The ownership structure transformed during the research period. The previously co-operative-owned forests got to private owners again, and even some of the state forests were privatized. Despite the changes in the ownership structure the state-ownership is still dominant nowadays.

There were typical changes in the forest area and the composition of the living tree stock by species. The forest area of some tree species increased (e.g. oak, beech, acacia), and others are reduced (e.g. hornbeam, conifers). A similar tendency can also be observed in case of the living tree stock by tree species. The rate changes, often resulted in a shift in the composition of tree species in the forest area and in the living tree stock. In several cases, the area of the forest of a certain tree species and / or the living tree stock increased, however its share of the national one decreased compared to the previous years.

The examinations proved that the health of our forests is still good. However, compared to previous years, there is deterioration in the health of forests, mainly due to climate changes. While the rate of trees showing no symptoms decreased, the rate of endangered trees grew

In spite of all the above facts I believe the changes in the field of Hungarian forest management during the past years have promising signs; the previous unfavourable lagging-behind situation in this field reduced and we keep catching up with the countries of the European Union that are ahead of us.

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