

STRUCTURAL DYNAMICS OF ROMANIAN FORESTS AFTER 1990

Eugen Rusu¹, Alina-Daniela Cojinovschi

Key words: forest, biodiversity, regeneration.

Abstract. The Romanian forest area in 2010 was 6,515 million ha, which represents approx. 27.3 % of the national territory. At European level, Romania is ranked 13 in the areas occupied by forests, but below the average forest coverage of 32 %. After a decline in forested areas recorded between 1990 and 2000 there was a slight rebound in the last decade, with an FAO estimated growth of over 30 000 ha per year between 2005 and 2011. This growth is primarily attributed to natural regenerations. If the production function is intrinsically provided in different proportions by all the functional categories, the protective function has a special attention, having clear typological distinctions, based on well-established natural or social components. Only maintenance work is allowed in protection forests. The total volume of timber harvested in Romania in 2010 was about 17 million m³, according to NFA upon reading the regeneration cuts of an area of over 99 hectares, 5000 ha of which by cuttings. Compared to 2000, when they harvested less than 14 million m³, one can see a substantial increase of approx. 20 %. In the same period, in 2010, the total area of artificial regenerations was about 10 000 ha, which represents a tenth of the cutting surface, the remaining land being regenerated naturally.

Introduction

It is estimated that at the beginning of the humanization of the territory, Romania was 80% covered by forests (Giurgiu, 2004). Apart from the Carpathian forests, large areas of hilly plains and even forests were occupied by the ancient and medieval West. Wooded areas were continually reduced by deforestation to obtain timber, in search of seeking new land for cultivation or

¹ Prof. PhD. "Alexandru Ioan Cuza" University Iași

grazing and by expanding settlements or means of communication. Currently, only about 27% of Romania's surfaces are still forested.

The reduction of forest areas of Romania continued after the political changes of 1989, due to irrational and sometimes illegal mining, which were practiced amid crumbling forestlands through partial repayment of former private property and the lack of enforcement authority and tolerance massive felling of forests. Giurgiu, 2010, states that the restitution is not over, because the state still owns 3.3 million hectares of forests in other forms of property and in opposition to optimistic reports, Romanian forest area will decrease further, as in recent years, because people and private entities will exploit wood resources.

Material and methods

The real appreciation of the difficulties of incomplete statistical data or the ones that do not reflect the real structural dynamics of the forests of Romania was the starting point of the study. The NFA advanced reports or the ministries to which the forests were attached sequentially are not truthful, because in some cases, the statistical data are identical every four successive biannual evaluations. It is impossible for certain indicators not to suffer any changes of the surface or the percentage share for a period of six years. The data sources that were used are those provided by the NIS, NFA, EFM, Corine Land Cover and refers to the period after 1990 particularly and in particular quantitative assessments for 2005, 2007, 2009 and 2011. Inconsistencies between data and reality were raised primarily by comparative analysis method.

Results and Discussion

According to the report published by the NFA, SILV1, Romanian forest area in 2010 was 6,515 million ha, which represents approx. 27.3 % of the national territory. At European level, Romania is ranked 13 in the areas occupied by forests, but below the average forest coverage of 32 %. The highest percentages of afforestation are found in Finland, holding 73%, Sweden 69%, Slovenia 62% and Russia 49%. The forest area per capita in Romania is 0.33 ha, far below the average well wooded countries: Russia 5.7 ha / person, Finland with 4.4 ha/inhabitant, Sweden with 3.1 ha/person and Norway with 2.5 ha/person. It is likely for this indicator to exceed the European value in the near future, given the downward trend in the number of inhabitants of Romania. The forest area occupied only by forests was 6.354 million ha in 2010, the remaining 161 000 ha, representing other areas

belonging to the national forest fund. After a decline in forested areas recorded between 1990 and 2000 there followed a slight rebound in the last decade, with a growth of over 30 000 ha per year between 2005 and 2011, estimated by FAO. This growth is primarily attributed to natural regenerations.

Table 1 The evolution of the total area of forests in Romania after 1990 (million ha) Source NFA

	1990	1995	2000	2005	2011
România	6,371	6,282	6,366	6,391	6,515

In 2011, the situation in the counties reveals major differences in the areas occupied by forests. The largest areas (over 250 000 ha) in counties are: Suceava, Caras-Severin, Hunedoara, Arges, Bacau and Neamt Valcea. On the opposite side there are a number of counties with very small areas of forest (below 40 000 ha): Călărași, Ilfov, Ilfov, Teleorman, Constanța, Brăila and Galați. If one takes the percentage into account, Suceava is still the most wooded county, having 51% of the territory covered by forests, followed by other counties, with percentages of 40%, which have an important mountain element surface (Vâlcea, Caras-Severin, Gorj, Neamt Covasna, Hunedoara).

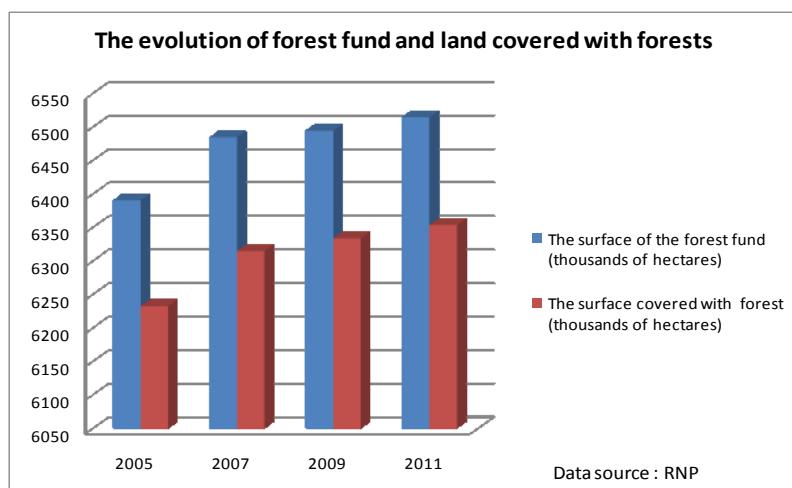


Fig.1.

Romania provides optimal conditions for the development of temperate forest types in different types of brushes. Climatic conditions differ very little from the latitude point of view, but they change in altitude, creating differences

that reflect the natural setting of various types of wood. Only in southwestern Romania there are some thermophilic species of trees and shrubs installed in an environment with warmer climate, having Mediterranean influences.

Table 2. The counties with the largest forest areas (thousand ha, 2011). Source: EFM

	SV	CS	HD	AG	BC	VL	MM
Thousand ha	435	389	309	276	271	268	263

Table 3. The counties with the lowest forest areas (thousand ha, 2011). Source: EFM

	CL	IF	IL	BR	TR	GL	CT
Thousand ha	21	25	25	27	28	36	39

Table 4. The counties with the largest forest areas (%), 2011). Source: EFM

	SV	VL	CS	GJ	NT	CV	HD
%	51	47	46	44	44	43	43

Table 5. The counties with the lowest forest areas (%), 2011). Source: EFM

	CL	CT	TR	BR	IL	GL	OT
%	4,2	5	5	5,4	5,8	8,1	9,5

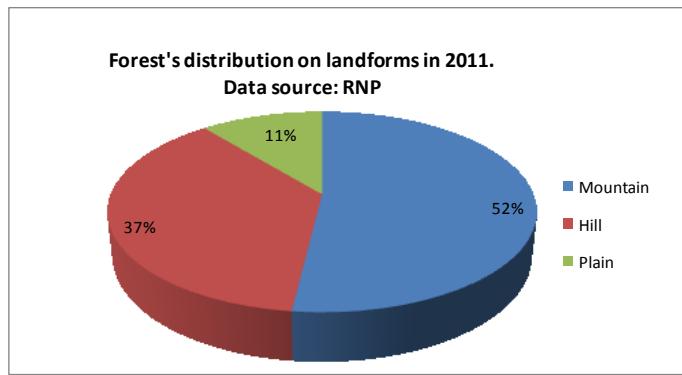


Fig. 2.

The analysis of the current level of afforestation of the country shows that Romania is underforested compared with other European countries showing morpho - pedo - climatic conditions like (Slovenia 62%, Austria 47%, Slovakia 41%). A 2010 European Union report states that forest area of 176 million ha exceeded union, which represents 32% of the territory of this organization.

Romania is far below the European average and much below the optimum afforestation level of 45% (Giurgiu, 2010), as stated by foresters.

Wide variations of forest areas occur among major relief units. More than half of the country's forests, about 52% of the total are located in the mountains and it represents 3.418 million ha. The considerable expansion of the forests in the mountainous regions of Romania was favored by several factors. The Romanian Carpathians occupy an area of 66300 km², 28% of Romanian territory being represented by mountains of medium height, bordered almost entirely in the boreal forest and nemoral from 400 - 500m in 1600 - 1800m altitude.

It is remarkable that about. 90% of the surface of the Carpathians is below the altitude of 1500m, in forest areas. Coniferous forests are present mainly in the Eastern Carpathians and the deciduous occupy larger territories in the Western Carpathians and the Southern Carpathians. Large areas of coniferous forests are situated in the upper forest floor, between 1500 and 1800m altitude. However, there are differences regarding the upper limit of forest between the north and the south. In mordor this limit is approximately 1600m, while in the south it is up to 1800m on the slopes with southern exposition. In the classification on phytoclimatic floors, the sub-alpine floor, situated between 1800 and 2200m, is included in the forestry and represents 1.2% of the total. Only peaks and the highest peaks that include meadows and alpine gaps are excluded from forest classification.

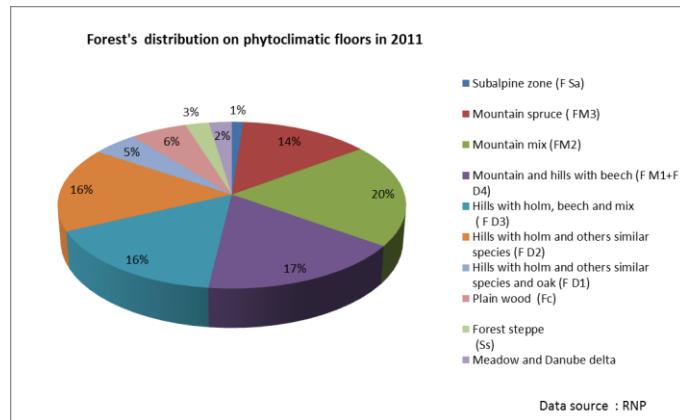


Fig. 3.

The hilly and plateau area include approx. 37.2% of the country's forests, ie 2.432 million ha and it falls almost exclusively in nemoral deciduous forest.

The altitudinal spread development of these forests is between 200 - 300m and 500 - 600m, in favorable climatic and edaphic conditions.

The deforestations in hilly area were more intense than in the mountains and were mainly made for new grazing land, for plantations of vines and fruit trees and for habitat expansion. Agrarian reforms of 1864 and 1920 affected the most forests in the hilly area, especially following the allotment and communal pastures extension deforestation.

The plains are the most deficient in forested areas. At low altitudes only thermophilic species resist, widespread in the forests and high plains of the steppe. The lowland forests were cleared for farmland expansion, especially for arable crops, currently reaching only 10.9 % of the forests of the country, accounting for 0.723 million ha. The current afforestation percentages are very low in some sectors: 4.1% in the Moldavian Plain, 3.5% and only 3.2% in Bărăgan.

The structure of forests Romania depending on species shows that the deciduous species, extended to all major steps relief in accordance with the thermal and rainfall temperate continental moderate climate.

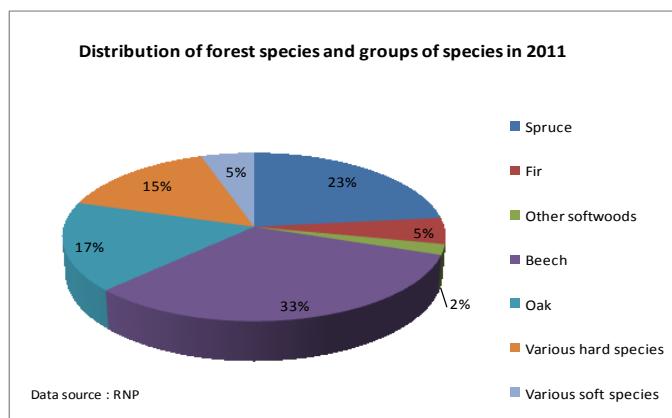


Fig. 4.

The resinous hold approx. 31% of all tree species and are confined mostly in the mountainous regions, mainly in the Eastern Carpathians. The spruce species is the dominant one (about 23%) that stands nearly in pure form from the top of the stage associated with tree boreal and the bottom of the floor. The second species, depending on percentage, the fir tree (5%), is a species more sensitive to the quality of the environment. Its percentage declined in recent decades and is found mainly in the lower boreal floor, but is also present at

lower altitudes, mixed with beech and other hardwood. Along with the dominant species, with much lower effective, there is the pine (3 %) present in low mountain areas and even in hilly areas of the south - west. Other species of coniferous forests of Romania, the larch, yew and *Pinus cembra* have become rare and are protected in reserves and national parks (the larch in Ceahlău, the *Pinus cembra* in PN Călimani), or they are disseminated among conifers.

The deciduous trees have a share of approx. 69% of all species of trees and a range of wider spread of plain or delta lowlands until the Carpathian forest floor below. According to the NFA, the phage has the largest share with 32% of all forest species in Romania, followed by the oak 17%, various species of hardwood with 15 % and various species of soft wood 5%.

The distribution of forests in age classes indicates a relatively balanced structure, with young reserves for future operating availability as well as reserves of tree cutting for the ones that have reached the optimal age.

The young, under 20 years, occupy large areas, representing 23% of the Romanian forests and they were planted or they are the result of natural regeneration in the period leading to the post-revolutionary period. Forest areas aged 21-40 and 41-60 years (19% and 18%) means 37% of the total, and they were reclaimed within communist programs.

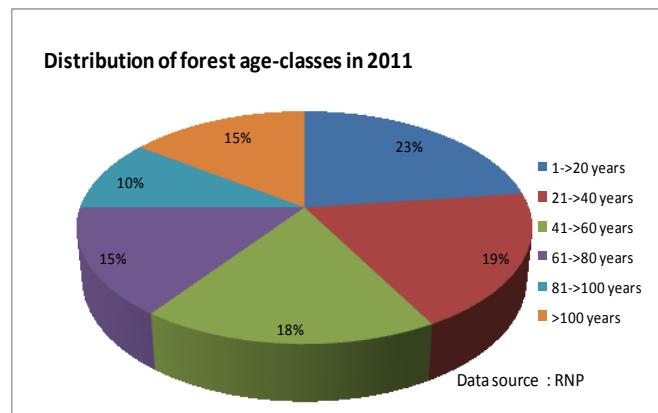


Fig. 5.

The stands operating at optimal age, the class age 61-80 (15%), 81 - 100 (10%), and 100 years (15%), together totaling 40% of the forest area of the country and support exploitation, development and export of wood and non-wood. The age that is optimal for operation varies depending on the species, the stationary conditions and woods. Species of soft wood and the ones that

grow fast are exploited at a younger age (the willow, the poplar, the locust 20-35 years), the lime from 50-100 years, while resinous and beech reach optimal cutting age after 100 - 120 years. The longest to live species are the oak, whose optimum cutting age exceeds 120 years (ONF). Some aged stands as reservoirs of biodiversity are preserved and protected in national parks and numerous natural reserves of historical, ecological and scientific importance.

The current trend is of growing the surfaces driven and regenerated naturally, and to increase the area planted to ensure the future vitality and balance in the age class structure of the forests.

The distribution of forests in functional groups indicate the Romanian foresters' concerns about ensuring and sustaining vital functions of forests, protection and production. Romania is currently falling within EU standards and the FAO on forest classification by functional groups, but with some small differences imposed by the tradition in the operation and management of forests and national specificities. If the production function is provided in different proportions in all categories intrinsically functional, the protective function has a special attention, with clear typological distinctions, depending on well-established natural or social components. In the protection forests only allowed maintenance work is permitted.

The functional classification of Romanian forests comprises two functional groups. Grupa I comprises special protection forests and production forests and functional Group II includes production function and protection forests. This classification was carried out following the principle of multiple functional areas of forest, according to which any forest has a protective function and a production one, but the classification was customized by assigning a priority function, depending on the location of forests and the protection needs.

The functional Group I, including special protection forests, has as a priority the component of environmental protection of natural elements (air, climate, landscape, water, soil and biodiversity), but it also carries out a task of social protection and scientific interest. Areas having this function represent 53.3% of the Romanian forests (ie 3,503 million ha) and are broken down into categories based on the location of protective forests, the intensity of natural processes, the presence of areas intensely humanized, the forest age, the social and scientific interest.

The concerns about the importance and support of the forest protection functions have become increasingly evident in recent decades in Romania.

Areas aimed at protecting land and soil surfaces have a share of 43% of the functional category, ie 1.228 million ha, and they are located mainly in

mountainous and hilly areas, where due to the brittleness geological substratum, the instability and erosion land suitability is the highest.

In the mountains, there came into this category forests of the Eastern Carpathians flysch area (pools Moldova, Bistrita and Trotuș, Vrancea region), petrographic mosaic areas in the Apuseni Mountains and Banat Mountains, and the hilly regions affected by landslides and gully processes (Plateau of Moldavia, Transylvania, the Sub-Carpathians, Western Hills). The vulnerability of these areas is given by the presence of surface deposits consistent quilts, but also brittle and vulnerable lithological constitution slope processes. If in the mountain areas the country, the forests are present in high proportions, and they offer protection to the lands, the hills and plateaus areas are more vulnerable because the forests protection is carried out in a much lesser extent because they were cleared in bulk and create intense discontinuities with current processes. There are well known cases of exacerbation of landslides and frequency of gully processes in Tutovei Hills, Central Moldavian Plateau, Curvature Sub-Carpathians, or Transylvanian Plain, the Somes Plateau region of forests have disappeared mostly in historical times. The restricted forest areas remaining in these regions are particularly effective against erosion.

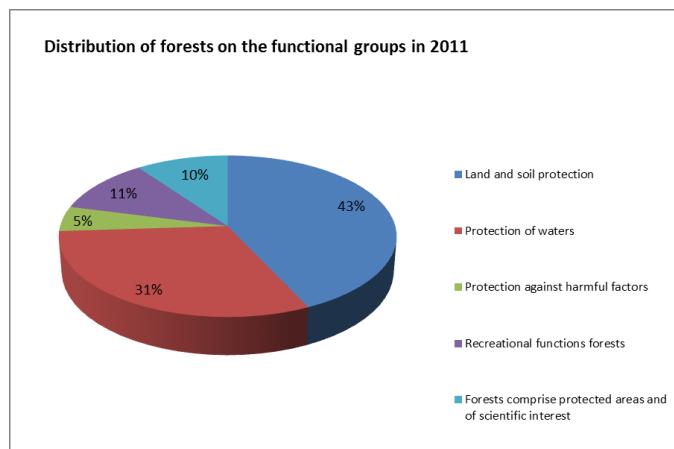


Fig. 6.

Recreation forests cover a total of 11% of the functional category (0.385 million ha) and they are intended for social and cultural activities. Forests are highly attractive and accessible, and in some sectors they are especially arranged for such purposes. All mountain resorts are surrounded by forests having a recreation function in the high traffic tourist activities. Borsa, Durău,

Lacu Roșu, Sovata, Slănic Moldova, Stana de Vale, Sinaia, Baile Herculane are just a few examples of the resorts that benefit from the curative effect of the surrounding forests. Weekend tourism has acquired a new dimension and new importance and by this the forests near towns are invaded by urban dwellers who try a change of scenery and recreation in nature. However, it is often the case of this type of tourism to bear the mark of voluntarism and it may harm the forest landscape.

Other woods are intended for educational or cultural heritage of the country. Slătioara secular woods, the Silver Forest and the Copper Forests near monasteries Agapia and Văratec, the Cernica Forest and Letea, etc., are just some examples of forests maintained as elements of historical and cultural heritage of the country.

The protection against pests is ensured by only 5% of the forests of Romania (about 0.175 million ha) and it refers to the protection of forest areas and industrial harmful climatic factors. Pre-existing forests that can perform this function or plantations that were made for this purpose were included in this category.

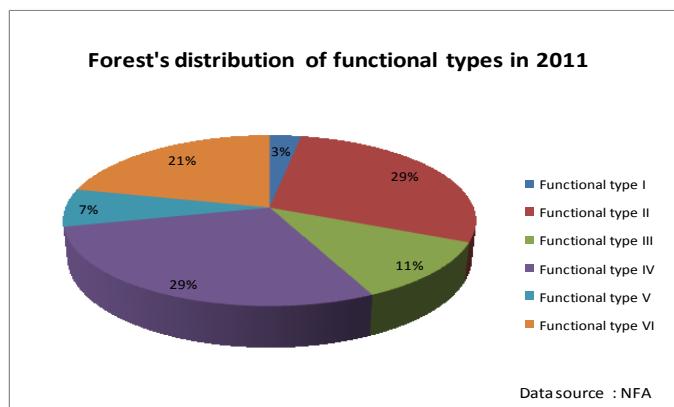


Fig. 7.

Few compact forests are designated to act as protection against harmful factors. The main tasks are fulfilled by outskirts and specific plantations. They are present around the city for retention of toxic dust released by industrial units polluting or toxic retention of combustion engine components autovehiculelor. Numerous shelterbelts and skirts were planted along railways and roads in order to prevent difficulties created by blizzards. Such facilities are present on sections of communication paths Romanian Plain, Plateau Moldova and Siret, areas exposed to winds in winter.

Under current guidelines in the European and global forestry, the biodiversity conservation function has become extremely important in the context in which this feature is threatened by the expansion of vital forest habitat and human activities. In Romania this function is performed by "forests and protected areas and the ones that bear scientific interest" in Group I function. These forest areas occupy 10% of this group (0.350 million ha) and are spread all over the country.

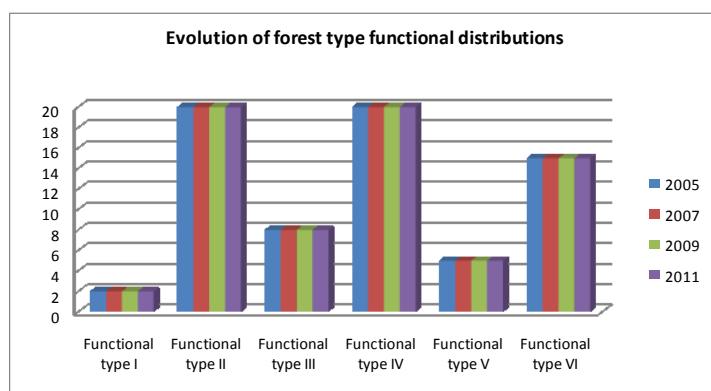


Fig. 8.

Located in the temperate continental moderate interference of various types of climates, Romania conserved different elements of flora and fauna: boreal, Ponto - Caspian, Mediterranean and Western Europe, which gives it a higher biodiversity than in European regions influenced by typical climates. The territory diversity in the delta and steppe, nemoral forests, boreal and alpine meadows Carpathian Romanian space favors the presence of many elements of biodiversity, some endemic.

The biodiversity protection and conservation is achieved primarily in protected territories legislative national parks, natural parks, protected areas and natural reservations. This function is fulfilled in the secondary forests and other forests that belong to functional group I.

In Romania there have been established over 20 national and natural parks and over 1000 nature reservations that are protected areas, some of which being of world importance, included in UNESCO heritage. All these areas of protection also include forest areas of great scientific importance for biodiversity conservation.

The production and protection function is ensured by 46.7% of the forests of Romania in the functional group II. In accordance with NFA within this

group there were established six functional types with different degrees of restriction of silvicultural treatments:

- Functional type I includes forests where silvicultural treatments are not allowed, only exceptionally, in agreement with the Romanian Academy.
- Functional Type II includes forests where only conservation works are allowed.
- Functional types III and IV where only natural regeneration treatments are allowed and exceptional cuttings are allowed in the case of certain species.
- Functional types V and VI where all forest treatments are allowed.

The production function provides requirements for industrial wood and firewood processing and mproduces. According to the principles of sustainable forestry products, it is necessary to ensure continuity of production of timber, exploited when they have reached harvestable age, usually over 100 years in the case of species that have high economic value.

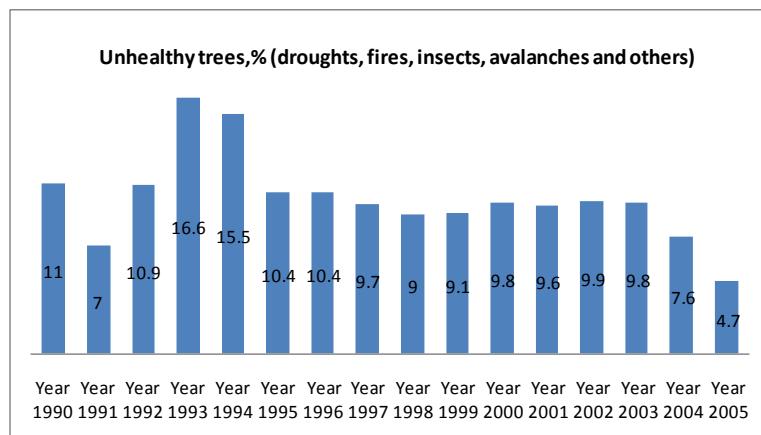


Fig. 9.

Age class structure analysis indicates a lack of exploitable trees (over 100 years), and pre-exploitable (80-100 years), caused by the massive exploitation of previous decades. The real share of exploitable trees is reduced because they contain mostly old forests having protective function and are included in protected areas. Exploitations in the past concentrated mainly in forests that were accessible overstrained the exploitable stands and at present, the low density of forest roads in areas that are difficult to access, make the capitalization of harvested forests difficult.

According to the report SILV1, 2010, the total volume of standing timber of Romania, or production fund is estimated at approx. 1413 million m³, with

an annual opportunity (availability of wood for exploited) approx. 22.3 million m³. In particular, there are slight differences between the occupied area and the volume of standing timber. Even though the resinous occupies an area smaller than a phage, the foot volume is slightly higher because of the higher density of the shaft. The volume of standing timber species was represented in 2007, by 39% coniferous, 37% beech, 13% oak and 11% various other species or soft ones.

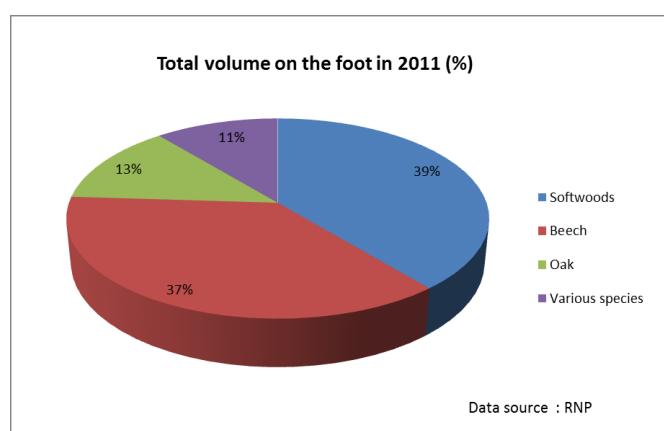


Fig. 10.

The average volume per hectare in the forests of Romania is about 218 m³, exceeding the European average amounts to approx. 147 m³/ha, due to good stationary conditions and the species diversity in the forest land. For the same reasons the annual growth of 5.6 m³/ha exceeds the European average of 4.4 m³/ha. Species and large groups of species, increasing the average current is 6.5 m³/ha resin, 5.5 m³/ha in beech, the oaks 4.7 m³/ha; 4.7 m³/ha in hardwood and 7.4 m³/ha soft leaved species (species that have rapid growth).

The capitalization of wood and forest is also based on availability, ie access roads network density within the forest. Biriş (2007) estimated that the total length of the access network in Romania totalling approx. 42,000 km, was made up of 32,000 km of forest roads and railways, public roads and adjacent industrial or cross forested areas.

The index density was estimated at 6.5m/ha, far behind other European countries with similar land topography: 45 m/ha in Germany, 28 m/ha in Switzerland and 26 m/ha, France.

In these conditions, about 2 million ha of forests are totally or partially inaccessible in Romania and timber harvest and silvicultural works execution are obstructed by topography or accomplished with difficulty.

Due to the high values of some morphometric characteristics of the relief (altitude, slope, depth and drainage density), the mountain is the most deficient in roadways, especially forest roads. To this other factors are added, such as the high density of river network, the brittle geological substrate and the slopes, overwetting of the slopes by precipitation and gravitational processes favoring the phenomenon of freezing - thawing, which creates problems of construction and especially railway maintenance access.

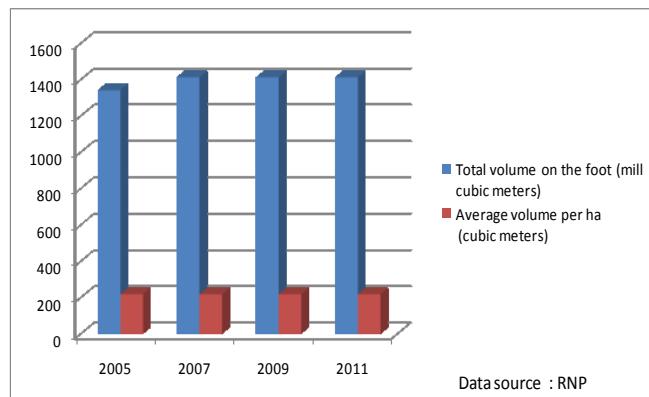


Fig. 11.

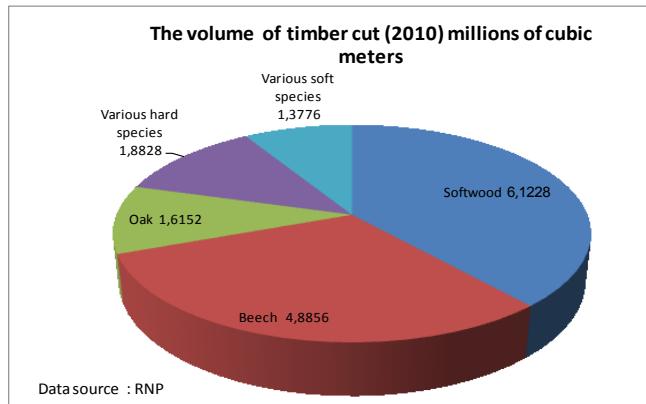


Fig. 12.

Table 6. The volume of timber harvested by region (% 2010). Source: NIS

Nord-Est	Centru	Vest	Nord-Vest	Sud	Sud-Vest	Sud-Est	B- Ilfov
29,3	23,0	12,3	12,1	9,2	7,2	6,5	0,4

Table 7. Artificial regenerations area by region (% 2010). Source: NIS

Nord Est	Centru	Sud-Est	Nord-Vest	Sud	Sud-Vest	Vest	B-Ilfov
26,1	19,7	12,9	12,1	11,3	9,9	7,3	0,3

Table 8. Forest regeneration work in 2010.

Year	Natural regenerations	Artificial regenerations	Total
2006	12.021	15.544	27.554
2007	12.026	10.716	22.742
2008	11.940	11.244	23.184
2009	11.891	10.962	22.853
2010	13.628	10.106	23.734

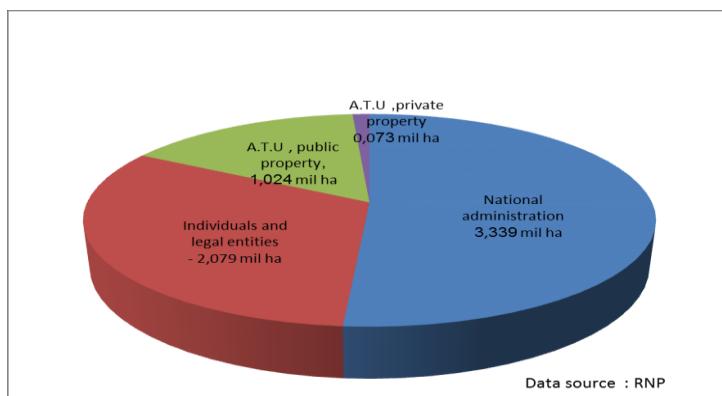


Fig. 13.

The total volume of timber harvested in Romania in 2010 was about 17 million m³, according to NFA upon reading the regeneration cuts area of over 99 hectares year, 5000 ha of which by cuttings. Compared to 2000, when they harvested less than 14 million m³, one can see a substantial increase of approx. 20%. The wood was extracted mainly in mountainous regions, the largest share being in the counties of Suceava and Neamt, which have had significant increases compared to 2000. These increases were primarily due to the accelerated pace of cutting in private owned forests. However, there are counties with large areas of forests that reported they had significant reductions of the quantities of timber extracted in the period 2000 - 2010: Mehedinți, Harghita, Cluj, Hunedoara. In the same period in 2010, the total area of

artificial regenerations was about 10 000 ha, which represents a tenth of the cutting surface, the remaining land being regenerated naturally.

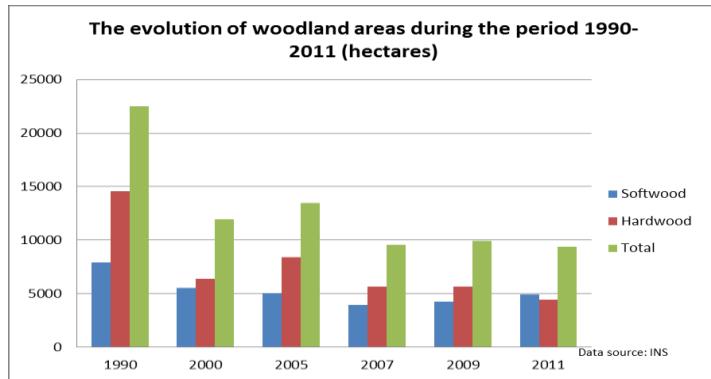


Fig. 14.

Table 9. The evolution of the timber extracted between 2000 and 2010 (thousand m³). Source: Econtext

No	County	Year 2000	Year 2010	Variation %
1	Suceava	1576,7	2299,6	46
2	Neamț	957,4	1253,1	31
3	Harghita	1131,5	999,8	-12
4	Bacău	696,7	869,6	25
5	Brașov	500,2	815,7	63
6	Caraș-Severin	511,5	767,1	50
7	Maramureș	475	639,8	35
8	Argeș	474,9	593,4	25
9	Arad	451	587,2	30
10	Mureș	570,7	554,5	-3
11	Alba	361	526,3	46
12	Covasna	466,7	511,6	10
13	Sibiu	377,8	503,9	33
14	Bistrița-Năsăud	439,8	476,6	8
15	Gorj	303,3	434,7	43
16	Hunedoara	459,7	438	-5
17	Bihor	269,5	426,6	58
18	Vrancea	387,7	392,6	1
19	Vâlcea	372,2	379,2	2
20	Prahova	328,2	373,7	14
21	Buzău	305,9	354,9	16

22	Timiș	251,5	295,8	18
23	Iași	249,5	271,3	9
24	Cluj	253,4	233,8	-8
25	Dâmbovița	221,2	229,7	4
26	Tulcea	179,5	183,3	2
27	Dolj	190,8	164,1	-14
28	Mehedinți	222,5	159	-29
29	Vaslui	172	152,4	-11
30	Sălaj	99,3	144,6	62
31	Botoșani	119	131,8	11
32	SatuMare	143	132,6	-7
33	Giurgiu	77,5	111,6	34
34	Călărași	112,9	110,6	-2
35	Ialomița	88,2	92,8	5
36	Olt	101,6	81,2	-20
37	Ilfov	91,9	70,8	-23
38	Brăila	79,9	60,9	-24
39	Galați	70,2	61,6	-12
40	Constanța	77	52,9	-31
41	Teleorman	76,4	52,4	-31
42	București	-	0,5	
43	Total Romania	14284,7	16991,6	18

Conclusions

According to the report published by the NFA, SILV1, the Romanian forest area in 2010 was 6,515 million ha, which represents approx. 27.3 % of the national territory. At European level, Romania is ranked 13 in the areas occupied by forests, but below the average forest coverage of 32 %. After a decline in forested areas recorded between 1990 and 2000 there was a slight rebound in the last decade, with an FAO estimated growth of over 30 000 ha per year between 2005 and 2011. This growth is primarily attributed to natural regenerations. The distribution of forests by functional groups indicates the Romanian foresters concerns about ensuring and sustaining the vital functions of forests, which are of protection and production. Romania currently meets the EU standards and the FAO ones on forest classification by functional groups, but with some small differences imposed by tradition in the operation and management of forests and the national specificities. If the production function is intrinsically provided in different proportions by all the functional categories, the protective function has a special attention, having clear typological distinctions, based on well-established natural or social components. Only maintenance work is allowed in protection forests.

The total volume of timber harvested in Romania in 2010 was about 17 million m³, according to NFA upon reading the regeneration cuts of an area of over 99 hectares, 5000 ha of which by cuttings. Compared to 2000, when they harvested less than 14 million m³, one can see a substantial increase of approx. 20 %. The wood was extracted mainly in mountainous regions, the largest share in the counties of Suceava and Neamț, which have seen important increases compared to 2000. These increases were due primarily to the accelerated pace of cutting private forests. There are, however, counties having large areas of forests, which have reported significant reductions in the quantities of timber extracted in the period 2000 - 2010: Mehedinți, Harghita, Cluj, Hunedoara. In the same period, in 2010, the total area of artificial regenerations was about 10 000 ha, which represents a tenth of the cutting surface, the remaining land being regenerated naturally.

Bibliography:

Biriș I.V., Mihăilă Elena, 2007 – *Administrarea durabilă a pădurilor*, Ed. CAPDD Bihor

Chiriță C., et al, 1981 – *Pădurile României*, Ed. Academiei R.S.R., București

Doniță N., Popescu A., Băjenaru B., 2007 - *Cercetari asupra vegetatiei Parcului National "Muntii Macinului"*, București.

Florescu, I.I., Nicolescu, N.-V., 1996 - *Studiul pădurii, Silvotehnică*. Vol. I, Ed. Lux Libris, Brașov

Giurgiu, V., 1993 - *Salvați pădurile României, patrimoniu național și european*. Ed. Arta Grafică, București

Giurgiu, V., 1978, *Conservarea pădurilor*. Editura Ceres, București

Giurgiu, V., 1982, *Pădurea și viitorul*. Editura Ceres, București

Giurgiu, V., 1998, *Quo vadis silva*. Academica, București

Giurgiu, V., 2000, *Evoluția structurii pădurilor României după natura proprietății*. Revista pădurilor, nr. 1., București

Giurgiu, V., 2003, *Conștiința forestieră la români*. Editura Snagov, București

Giurgiu, V., 2004, *Gestionarea durabilă a pădurilor României*. Silvologie III B, Ed. Academiei Române, București

Giurgiu V., 2010 – *Pădurile și schimbările climatice*. Revista pădurilor, nr. 3, București

Giurgiu V., 2010 – *Considerații asupra stării pădurilor României*. Revista pădurilor, nr. 2, București

Pașcovschi, S., Sburlan, D., 1966 - *Pădurile României*. Ed. Agro-Silvică, București

Petrescu, L., 1976 - *Silvicultură*. Manual pentru licee cu profil de silvicultură și exploatare forestiere, anul III. Editura didactică și Pedagogică, București

Stănescu, V., 1997 - *Flora forestieră lemnosă a României*. Ed. Ceres, București

Ungur, A., 2008 - *Pădurile României*. Ed. Delavada, București

Untaru, E., 2010 - *Premise privind împădurirea terenurilor degradate în condițiile schimbărilor climatice generate de încălzirea globală*. Revista pădurilor, 1

Vlad, I., Chiriță, C., Doniță, N., Petrescu, L., 1997, - *Silvicultura pe baze ecosistemice*. Ed. Academiei Române, București

FAO, 2011- *Situation des forêts du monde*, 2011, Rome

FAO, 2010 – *Evaluation des ressources forestières mondiales*. 2010, Rome

FOREST EUROPE, 2012 - *State of Europe's Forests 2011*, UNECE & FAO

NIS, – *Activitatea din silvicultură în 2010*. Comunicat de presă nr. 110/31 mai 2011

NFA – *Starea pădurilor 2010*, Raport SILV 1

WWF – *Păduri și arii protejate din Carpați* - Raport anual 2010, WWF Romania

Abbreviations:

FAO – Food and Agriculture Organisation

IUCN – International Union for Conservation of Nature

EFM – Environment and Forest Ministry (Ministerul Mediului și al Pădurilor – MMP)

NFA – National Forests Administration (Regia Națională a Pădurilor – RNP)

WWF - World wildlife Fund

NIS – National Institute of Statistics (Institutul Național de Statistică – INS)