CURRENT TRENDS OF DEVELOPMENT OF FOREST AREAS TO PROTECT SOIL AND WATER AT GLOBAL AND REGIONAL LEVEL

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Abstract. Forest assemblage secures and protects the soil. The role of protection of forests is multiple, but the protection function of soil erosion and current geomorphologic processes is the most important one. The forest area having the primary function to protect the soil and water, avalanche control, desertification and coastal protection is now over 328 million ha, which represents approx. 8% of world forests. Compared to 1990, this protective function of soil and water has increased by over 100 million hectares of plantations and employment due to recent additional surfaces.

Keywords: *forest, soil, water, protection, treds of development, regional level*

Introduction

Forest soil acts as a body having a functionality and biodynamic permanently and consistently supported by internal and external exchanges. Forest soils have greater complexity than those with pastoral or agricultural use. A heterogeneous forest, under the optimal stage of development (climax), provides a greater quantity and variety of products for bioaccumulation circuit than a lawn or a crop. A forest is divided into layers of vegetation, having various components: moss, plants, grass, undergrowth, bushes and trees, which provide soil with decomposing plant debris of very different contents.

The forest vegetation forms with the soil a continuous circuit through which the soil provides the necessary nutritive material from the root to the last leaf on top, and the substances used by the trees are taken back to the soil by tree debris litter forming. Depending on the type of root system, the soil provides the trees a high supply of nutrients or useful for the domestic production of trees. Root systems extract more minerals from deep horizons, while supplying the trees with shallow roots such as organic nutrients provided by humus in the upper horizons. Unlike herbaceous plants or crops that have a reduced root system, with implantation in the upper horizons, metric dimensions of tree roots give stability and better opportunities for exploration and exploitation of soil. Thus, the roots are specialized deep rooting systems, depending on the depth at which it develops. The ones located in the surface soil horizons, fewer and smaller, supply trees with organic-mineral components of forest humus, necessary for the process of nutrition and tree growth. Roots penetrating the soil and reaching the underlying rock sometimes extract more mineral components, some on vitamins necessary to sustain a kind of overall resistance of the tree and wood building substances. There are essential differences between wood roots, grown in soil, in a solid wood and moist air environment and the trunk developed in air environment. The wood has a greater root density, mechanical strength and elasticity compared to wood trunk.

Between forest and soil, there arises a reciprocal, ongoing relationship that works depending on seasonal cycles of varying duration. In addition, the forest is a moderator of the excesses, providing protection against soil erosion, a constant thermal environment, a moderate and slow water infiltration and a large amount of organic matter for processing and transformation. Following a natural interaction model improved over time, soil supports and supplies forest and the forest supplies, defend sand protect the soil..

The soil is a three-dimensional physical volume that supports the forest physically and ensures its supply of water and nutrients. Genesis, evolution and maintenance of forest soil in optimum functionality is a prerequisite for sustainability of forest ecosystems. Soil is an interface equipped with skills of self-preservation, to maintain a specific biocoenosis assets and opportunities for normal decomposition of organic matter, according to stationary conditions. When one interferes with forestry and forestry work, morphology and physical properties of the soils are at risk of compacting processes, destruction of the structure, reducing porosity or mixture of horizons.

The branches and leaves of the trees reduce rainfall aggression and plant density cushioning elements of surface flow, reducing concentration and rainfall erosion. Dense network of roots keeps the soil in situ and controls processes such as gravitational soil flows, which could affect the upper horizons of forest soils. Wooded slopes are better protected against gap-forming processes of landslides, collapses and rolls. In areas with frequent and abundant rainfall, vegetation well embedded in trees, shrubs, grasses, mosses, litter, limits the effect of surface erosion on slopes and soil washing. This benefit has an even more important role in mountain areas with steep and long slopes, where the surface flow is enhanced by the tilting of the land.

Forest formations create a significant buffer effect against the rising surface temperature, maintaining humidity and promoting a longer period of time altering plant debris from soil. Oxidation processes are more attenuated and favour oxidation-reduction processes. Water evaporation from the soil is made difficult due to the protective layer of litter and secondary salinisation processes do not occur, but in the case of natively salt-rich geological substrate.

The forest assemblage secures and protects the soil in mountainous or hilly areas, where wind speed is increasing, being known as the phenomenon of "venture" and it thus gets higher values, the forest reduces the wind force and wind erosion, protecting the soil. The most vulnerable to wind blows are the coniferous forests with shallow root system. Especially on sloping land, with thin soils developed on blankets or unstable flysch, conifers are exposed to the ravages of wind.

The vulnerability and instability of podzols is added to this predisposition, associated and developed, at least in theory, under coniferous forests. Podzols reference horizons, E spodic, B spodic and B humic-spodic are porous and brittle and do not ensure good stability of trees. However, when wind speed exceeds the threshold of risk, tree ruptures are produced by wind. Most of the times, felled trees are dragged to the ground with all roots, creating a specific micro-relief of cavities due to topographic initially dispersed. In these areas, the soil no longer has continuity and is exposed to erosion and mixing of horizons.

Biocenoses support forest soil processes by offering significant accumulation of organic debris, plant or animal origin. Debris in a forest is more diverse than in pastures and cultivated fields, because the vegetation is stratified and each floor has its own

production plant debris. Manufacturing process is done slowly and humus in forest soils can see most clearly the three organic horizons classic litter horizon (Ol), fermentation horizon (Of) and humification horizon (Oh). Litter horizon is renewed annually with a fresh layer of leaves, twigs, seeds, fruit and other organic debris. Below there is the fermentation and fragmentation horizon, in which organic matter is decomposed and alteration starts. Then, the in-depth humification horizon, the humic compounds are produced and mixed with the geological mineral substrate surface. Humus thus formed constitutes the horizontal reference element and ensures the soil fertility

The role of protection of forests is multiple, but the most important one is the protection function of soil erosion and current geomorphologic processes. In recent decades, the process of desertification has become widespread in the Sahel, the Horn of Africa, Central Asia, China and other parts of the world. One of the most effective measures to stop the advancing of sand dunes is by mechanical fixing or by planting forest buffers curtains. To stop aridity, one of the programs is aimed at revitalizing the current forest Sahel, destroyed by drought and woodcut, by recovering damaged wood fire, while the rainfall in recent years is close to normal media.

In high mountain areas with steep slopes and cornices that are shattered by the winds gather snow, avalanches often occur, having destructive effects on the ground and buildings. The forests of the upper bodies or on the slopes can slow down or even stop avalanches, but the destruction of many trees remains, not only because the snowpack is destructive, but because of the displaced rocks, which are driven away by the gravity force.

Evolution of forest areas to protect soil and water

According to FAO estimates, forests and other wooded land currently cover approx. 4.1 billion hectares, representing 31% (almost one third) of the terrestrial land surface. Since the beginning of mankind, forest area has experienced a continuous rebound and cleared land has acquired different destinations.

Table no 1. Share of forest surface on total continents surface (Data source :FAO)

Region	Africa	Asia	North +Central America	Europa	South America	Oceania
%	21,4	18,5	32,9	44,3	47,7	24,3

Forest area which has the primary function of soil and water protection, avalanche control, desertification and coastal protection is now over 328 million ha, which represents approx. 8% of world forests. Compared to 1990, 100 million hectares of plantations were added to this protective function of the soil and water due to recent additional surfaces.

Substantial increases in forest cover, having protective function, are mainly due to efforts made by China for halting desertification and soil erosion, the Loess Plateau in particular. In North America, large areas having this function are assigned to the multiple uses due to another kind of vision of forest functions.

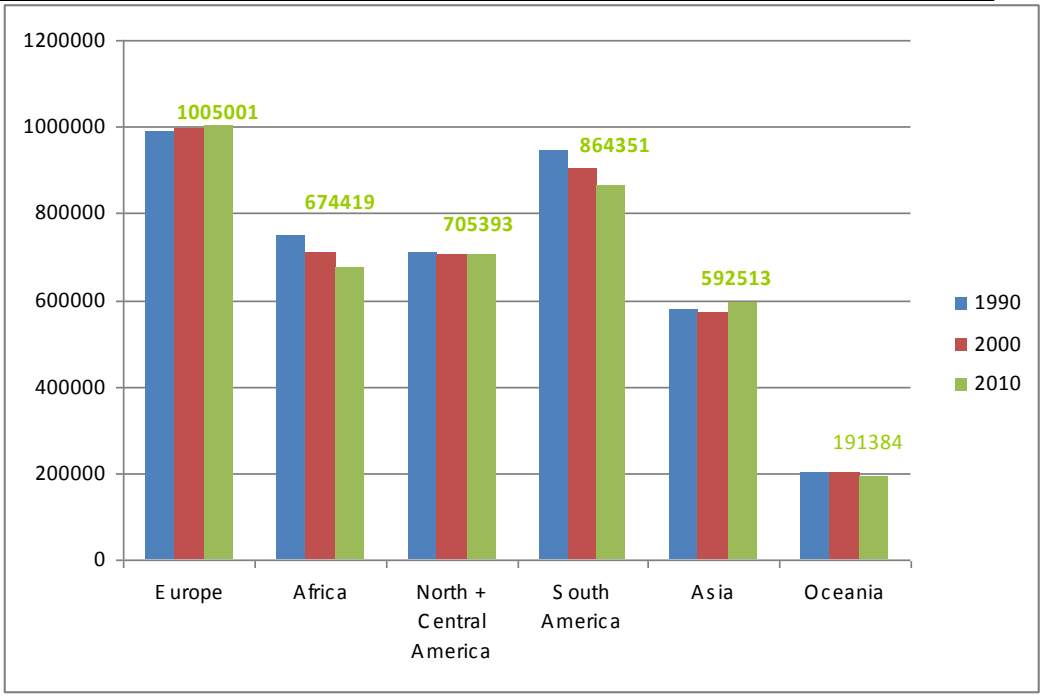


Figure 1. Evolution of total forest surface at regional level (thousands of ha., data source :FAO)

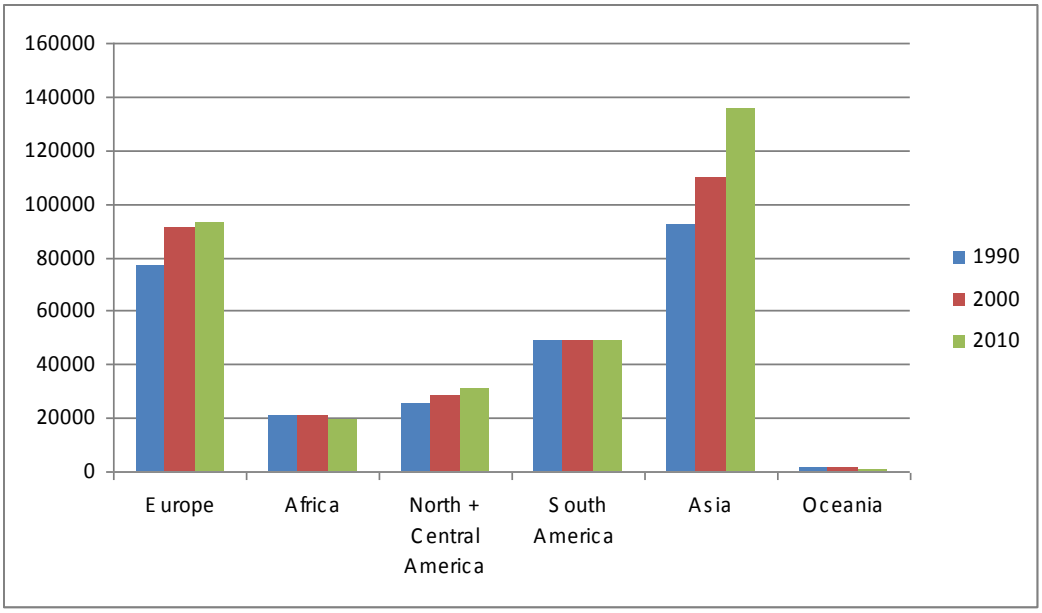


Figure 2. Evolution of forest surfaces dedicated to water and soil protection at regional scale (thousands of ha., data source :FAO)

According to Leslie (2005), current trends in the demand for firewood and wood industry are relatively stagnant, the requirements of ancillary products (non-wood) are

slightly increasing, although the requirements for social services provided by environmental protection and forestry are growing. This trend is supported by several factors.

Firstly, more and more policy makers and numerous non-governmental organizations worldwide are becoming aware of the importance of the protective function that the forest environment has. In developed countries concerns for conservation of forests, to restore deforested areas and even the planting of new areas are generalized to the entire society.

An up-to-date subject, which introduced the widespread publicity and concern, is related to the problems (real or hypothetical) created by the climate change and radicalization of weather events. In this context, the forest appears as a factor of balance and moderation of excesses climate locally, regionally and globally. World conferences of Kyoto, Copenhagen, Cancun or regional awareness resulted in individual and political impact of human activity on the forest - the main element of Earth's climate balance. Studies on some forests in Colorado and British Columbia (Veblen, 2008) showed that warming of 0.5 º C led to double tree mortality over a period of 30 years. Increases in frequency and intensity of forest fires due to prolonged droughts, especially in Mediterranean and temperate regions are also mentioned.

Other studies show beneficial effects on forests, by accelerating the growth rate of trees and natural advancement at the expense of tundra forest areas.

Chaotic deforestation in some parts of Africa, South America and Southeast Asia directly or indirectly induced economic, social and environmental problems. China faces serious amplified soil erosion and landslides resurgence in the Loess Plateau and the Chang Jiang basin, directly caused by the actions of deforestation and agricultural land expansion. Run-off slopes grubbed and rapid concentration in the drainage basins deforested caused devastating floods in Brazil, China and even in Romania (Trotus basin, Târlişiua basin, Tutova basin, etc).

Forestation programs, successfully promoted in Southeast Asia, Europe and the U.S. or less popular in other regions, are primarily designed to protect slopes, soil and water. Other forestations are meant to strengthen riverbanks erosion of concave banks and advancement at the expense of minor bed cultivated areas or habitat.

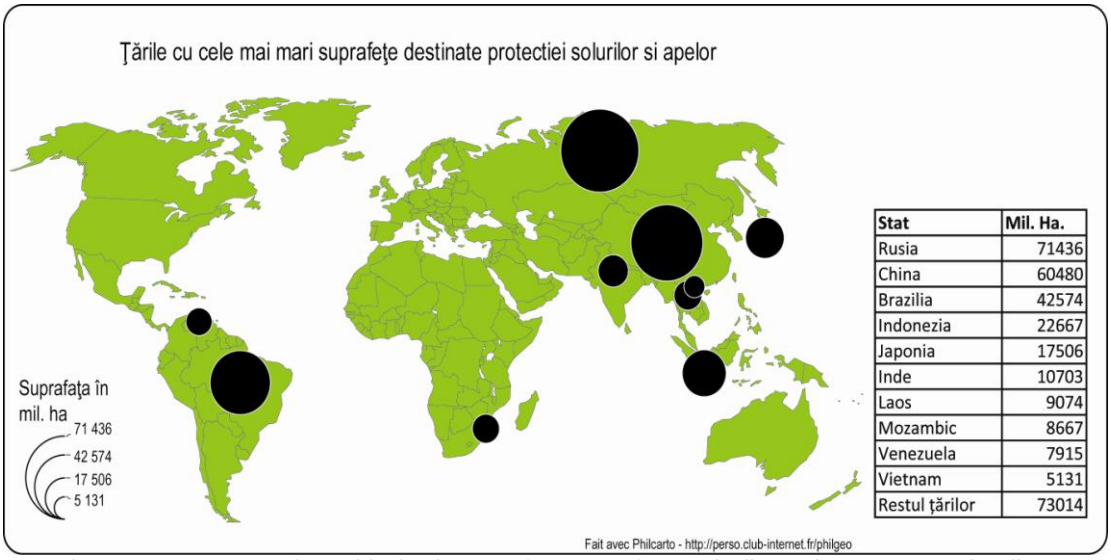
Aridity of certain territories and the mechanical expansion sand dunes over cultivated areas or inhabited ones, create problems in Africa, the northern edge of the Sahel and in parts of Central Asia. The most effective solutions are the creation of forest belts and dune planting operations, easily obtained, but difficult to maintain due to water shortages in these regions

The disappearance of mangroves and increasing coastal erosion in Bangladesh, the coast of Guinea Golf, or the Caribbean islands, require urgent action to restore the ecosystem with important role in coastal protection and biodiversity conservation.

The current possibilities and preferences of tourism practice, especially at weekends, for forested areas and ozone are almost generalized. This is an excellent people's emotional attachment to the forest environment and to the induction of biodiversity conservation concerns.

All these problems and the positive examples of successful actions in the field of forestation have resulted in the amplification of interest in forests as their purpose is the

protection of soil and water. Recent trends are to increase the affected area for this purpose, either directly through the action of planting vulnerable areas, or indirectly through the policy of awarding the functions of new areas of existing forests.



Stat	Mil. Ha.
Rusia	71436
China	60480
Brazilia	42574
Indonezia	22667
Japonia	17506
Inde	10703
Laos	9074
Mozambic	8667
Venezuela	7915
Vietnam	5131
Restul ţărilor	73014

Figure 3. Top countries with the largest forest surfaces dedicated to water and soil protection (mill. of ha., data source :FAO)

Worldwide there is substantial increase of forest areas that mainly function as soil and water protection. In the last two decades the best results were achieved in Asia, Europe and North America. In South America, Africa and Oceania, these areas have decreased significantly, mainly due to uncontrolled and speculative deforestation. Other causes are related to numerical growth of population and pressure on forest area, the expansion of pioneer crops in the Amazon and Congo River, the construction of roads and some industrial activities or mining.

Asia-wide wooded areas showed a continuous decrease until 90 years and after that, recovery continued through massive forestation programs promoted by some Member monsoon. Across Asia, according to FAO, forests designed to protect soil and water resources occupy 19% of the total forest area, which means approx. 125 mill ha. Compared with other continents, Asia has the best development of soil and water protection forests established: between 1990 and 2000 this function 17 million ha were added and between 2000 and 2010 another 26 million ha.

In East Asia these areas have increased especially due to forestation carried out on land cleared and to a smaller extent due to the inclusion of new forest areas in this category. Among nations that have made large areas of forest plantations, China is the leader, which cleared forested areas and desert areas in the startling pace: 2 million ha / year in the decade from 1990 to 2000 and 3 million ha / year in the decade from 2000 to 2010. Trees were planted in the priority problem areas of Loess Plateau, Manchuria, Sichuan and the marginal areas of the western deserts. In two decades China has added 50 million ha of new forest areas through large-scale national programs, but also by the help of the local communities. Objectives suggest that by 2020 China's forest area is to increase

by another 50 million ha. The largest part of these plantations has been made to protect soil and water. It is an amazing example that reflects the multifunctional role of forests understanding, political will and positive visionary thinking as well as the current financial and economic power of China. Other states with good results in forest restoration, not equalizing the size of China, are India, Vietnam and Bhutan.

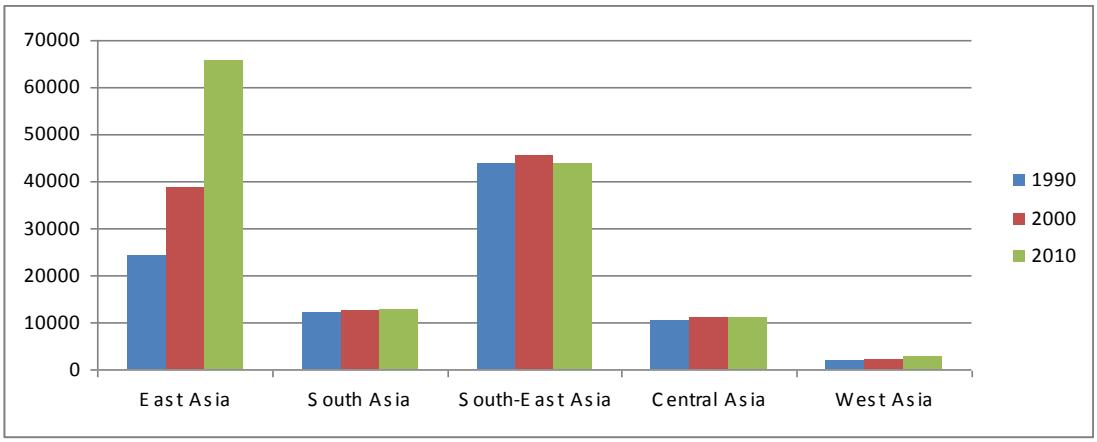


Figure 4. Trends in the evolution of forest surfaces with soil and water protection function in Asia (thousands of ha., data source :FAO)

Good results, but small-scale, were recorded in the arid regions of central and western Asia, where they added new planted areas in order to stop land mobile setting. In contrast, South Asia and South-East have lost relatively small areas in this category in the decade 2000 - 2010, with every effort made by India and Vietnam in forest plantations.

In **Europe** (including Russia), forest area designated to soil and water protection has seen a significant increase from 76 million ha in 1990-92 mill ha in 2010, representing approx. 9% of the total forest area. About 3 million hectares were added in the old continent (especially the soles) and approx. 13 million ha. In Russia (especially the framing of new forest areas in this category).Good results regarding the development of forest plantations with a protective role were recorded in the last two decades in the Mediterranean countries (Spain and Italy) and the Nordic countries (Sweden and Finland), plus France, Bulgaria and the Republic of Moldova).

The increase of forest areas with protective functions in Europe is due primarily to the awareness campaigns regarding the role of the forests, a concern induced by climate change (storms in Western Europe in December 1999) and the desire to restore forest companies sacrificed for the development of Europe.

In the context of a wise European policy, France has doubled its forestry area in the last 150 years, and Hungary in the last 70 years. Russia joined the global trend and changed the destination of production forests, turning them into spaces of soil and water protection. Europe is the continent where forest sciences developed early and contributed to higher management and forest exploitation, paying special attention to a good balance between production function and protection.

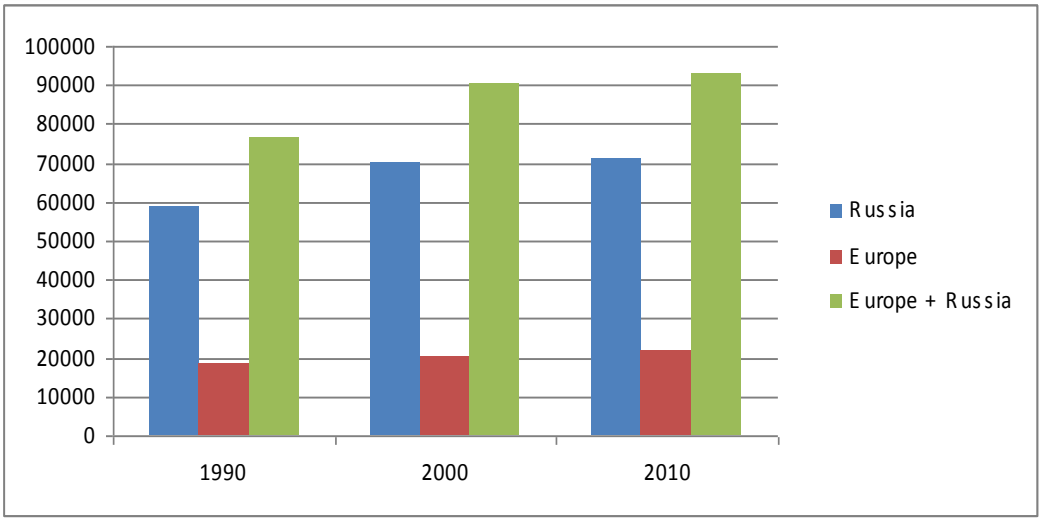


Figure 5. Trends in the evolution of forest surfaces with soil and water protection function in Europe (thousands of ha., data source :FAO)

African forest situation is dramatic because of the deforestation scale and human pressure on forest areas. Africa is close to 1 billion people and further population increases rapidly. Large forest areas are killed annually by speculative exploitation and use as firewood.

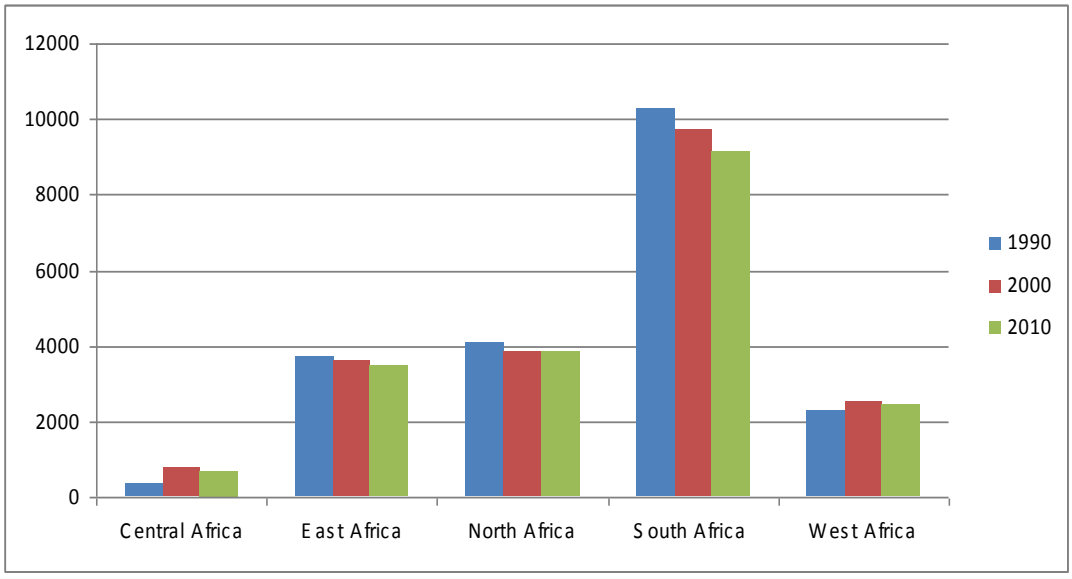


Figure 6. Trends in the evolution of forest surfaces with soil and water protection function in Africa (thousands of ha., data source :FAO)

The total area for soil and water protection in Africa is only 20 million hectares which is about 3% of all forests. Compared to 1990, these forests in Africa have

continually diminished its surfaces in the last two decades. Although some states declared that they allotted a large proportion of the forest area to this purpose, these exploitation patterns are not respected and industrial or fire wood continues. Mozambique said nearly 9 million hectares (half of Africa's forests for this purpose), Kenya recorded 3.3 mill ha, Sudan 2.4 million ha. These three countries together account for three quarters of the forest soil and water protection in Africa, while the Democratic Republic of Congo has 154 million ha of forests (more than a quarter of Africa) and has no protection under this category.

The largest areas are declared in the region of South Africa (almost half of all Africa) and, contrary to expectations and needs, the lowest areas are in Central Africa. The situation is contradictory, as Central Africa has climates rich in rainfall and the erosion rate is high and water quality protection is absolutely necessary. The situation regarding the areas with problems (erosion, desertification) is far from the continent needs. In the last two decades only four million hectares of planted forests have been added to the forests of Africa, leading to the year 2010 at a total of 15 million ha, of which 12 million ha having species introduced from other continental ecosystems. North African countries are the most dynamic ones, from this point of view, with over half the planted forests of the continent. This position is explained by the urgent need planting slope basins of the Atlas Mountains, where sudden increases in flow cause strong instantaneous erosion.

In **North America**, important forest areas have been designed to protect soil and water. According to FAO, soil and water protection in the region is integrated in the legislation, and policies and practices of sustainable forest management, forest areas are included in multiple function areas.

Concerns for forest restoration through planting of North America have good results. There are 37 million ha of forest plantations, which represent 6% of forest area and 14% of the world total. The situation is different in each country, but there is a positive trend of continuous growth areas planted, particularly in areas that were heavily exploited during periods of economic development or affected by strong erosion of soils (Bad Lands). Of the total national forests, U.S. planted area has 8%, Mexico 5% and Canada 3%. In the rest of Central America and the Caribbean there are small planted areas. Some areas in the ones affected by the forest fires in Canadian boreal forest, which are especially difficult to reach, are left to natural recovery and development, thus maintaining their status as primary forest. Most of these forest plantations are designed to protect the soil and water.

Table no.2. Trends in forest plantation with protection function in Central and North America (thousands of ha., data source :FAO)

Country/Year	**1990**	**2000**	**2010**
Canada	1 357	5 820	8 963
Mexic	350	1 058	3 203
USA	17 938	22 560	25 363
Caraibean	391	394	547
Central America	445	428	584
Total North and CentralAmerica	19 881	30 260	38 660

In Canada and the U.S., concern for preserving the natural values of ecosystems has become a modern concern which is almost general. There are states with high financial potential that can afford to allot substantial funds to the designation and management of large protected areas. They established a functional legal system in this field and have provided education, awareness and control mass efficient functioning forest parks and nature reserves. Over 8% of Canadian forests, 10% of the U.S. and 13% of Mexican forests are currently protected forest areas, which represent almost a tenth of continental forest.

Forest area of **South America** continues to decrease. At regional level, the forest lost approx. 88 million ha between 1990 and 2010, with an average loss of 4.2 million ha annually. These reductions represent 64% of the total concern worldwide and although losses took place at a slow pace, they are still high.
In South America, areas for the soil and water quality protect witness slight increase, amounting to approx. 7% of forest area at present.

Table no.3. Trends in forest plantation with protection function in South America (thousands of ha., data source :FAO)

	1990	2000	2010
South America	48 656	48 661	48 549

Amid the disappearance of large forest areas and other categories of land use, regional countries are striving for forestation of deforested land. In relation to the region's forest area, forest plantations account for only 2% of the total planted area but they have a higher percentage of participation at global level, namely 6% of the world plantations. States holding the largest forested areas in plantations and the largest growth rates of planted areas are Brazil, Chile, Argentina, Uruguay and Peru.

Table no 4. Trends in forest plantation in Central and North America (thousands of ha., data source :FAO)

	1990	2000	2010
America de Sud	8 276	10 058	13 821

According to FAO statistics, in the whole region of **Oceania** the wooded areas have decreased, in the last two decades, from about 200 million ha in 1990 to 191 million ha in 2010. Losses have occurred because of logging and land use as well as the change of certain forest roles, especially in Australia (0.5 million hectares lost between 2000 to 2010) and Papua - New Guinea (loss of 300 000 ha between 1990 - 2010).

Table no. 5. Evolution of forest surfaces in Oceania (thousands of ha., data source :FAO)

	1990	2000	2010
Oceania	198 744	198 381	191 384

Especially in Australia and New Zealand there are almost general concerns to maintain a balance between human activities and the natural environment. In this context, in the whole Oceania, the areas where forests were planted increased in the last two

decades from 2.5 million hectares available in 1990 to 4.1 million ha in 2010, with a rate of 2.3% / year. Deforested areas have been planted, tree food plantations have been established or they have been protected by some degraded lands, especially in regions with heavy rainfall (New Zealand, Hawaii).

Table no. 6. Trends in forest plantation in Oceania (thousands of ha., data source :FAO)

	1990	2000	2010
Oceania	2 583	3 323	4 101

Protected forest areas in Oceania reach a proportion of 22% of the total in the last decades due to the attention given to the preservation of natural forests in the state of functionality. The top countries of the region are New Zealand, where almost a third of forests are protected by general awareness and environmental imperatives of subordination of all activities.

Table no. 7. Trends in forest plantation with protection function in Oceania (thousands of ha., data source :FAO)

	1990	2000	2010
Oceania	1 048	1 078	888

Forests to protect soil and water, had a slight increase between 1990 and 2000, but experienced a significant decline in the last decade, from 1 Mill ha to 890 000 ha, in more accessible areas.

If at global level, the protection function areas in general and protection of soil and water in particular, have experienced significant growth in **Romania** the situation is not very clear in the case of these forests. According to data published by FAO, forest area in 2010 Romania was 6.573 million ha, which represents approx. 27% of the national territory.

Tab. nr. 8. Evolution of forest surface in Romania (millions of ha., data source :FAO)

	1990	1995	2000	2005	2010
România	6,371	6,282	6,366	6,391	6,573

At European level, it is ranked 13 from the point of view of areas occupied by forests, but it is below the European average forest coverage of 29.3%. The highest percentages of forestation have been recorded in Finland 73%, Sweden 69%, Slovenia 62% and Russia 49%. Area of forest per capita in Romania is of 0.33 ha, well below the average in well-forested countries: Russia by 5.7 ha / person, Finland with 4.4 ha / inhabitant, Sweden with 3.1 ha / inhabitant and Norway to 2.5 ha / inhabitant. After a decrease in forest areas registered between 1990 and 2000 there followed a slight revival in the last decade.

As far as the forests having as their main function the protection of soil and water are concerned, between Romania and of the FAO there are differences. Romanian system of classification of these forests is included in Group I function: protection forests and production forests, which represent 53% of Romanian forests (MARD, 2007). From this group, land and soil protection is provided by 43% of forests and water protection

assigned to 31%. For the protection against harmful factors there are allocated 5%, the recreational function is assigned 11% and the protected forests and the ones of scientific interest 10%.

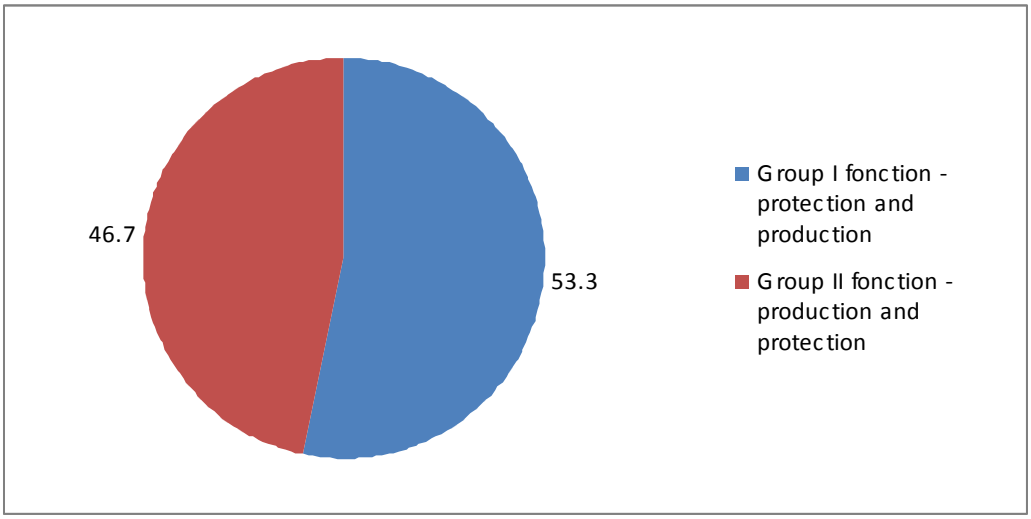


Figure 7. Functional structure of forest surfaces in Romania (%, data source : MADR)

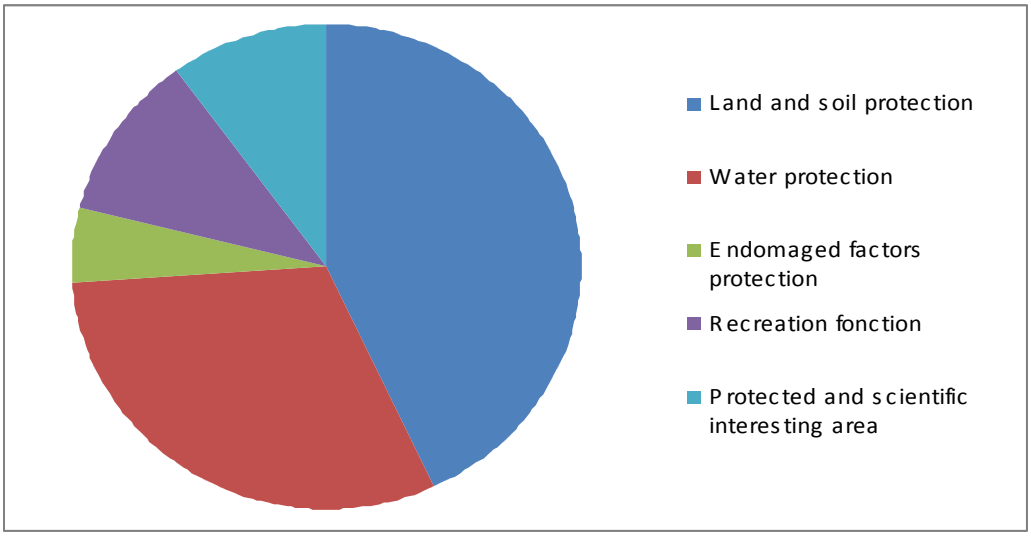


Figure 8 Structure of forest surfaces included in the first Functional Group (%, data source: MADR)

The forests in functional Group II, production and protection forests, account for 47% of the total forest area of the country.

According to FAO assessments, Romanian has a different functional structure, with 48% of forests for the production function, 39% allocated to soil and water protection, biodiversity conservation 5%, 6% is designated to cover social function and 3% for other functions.

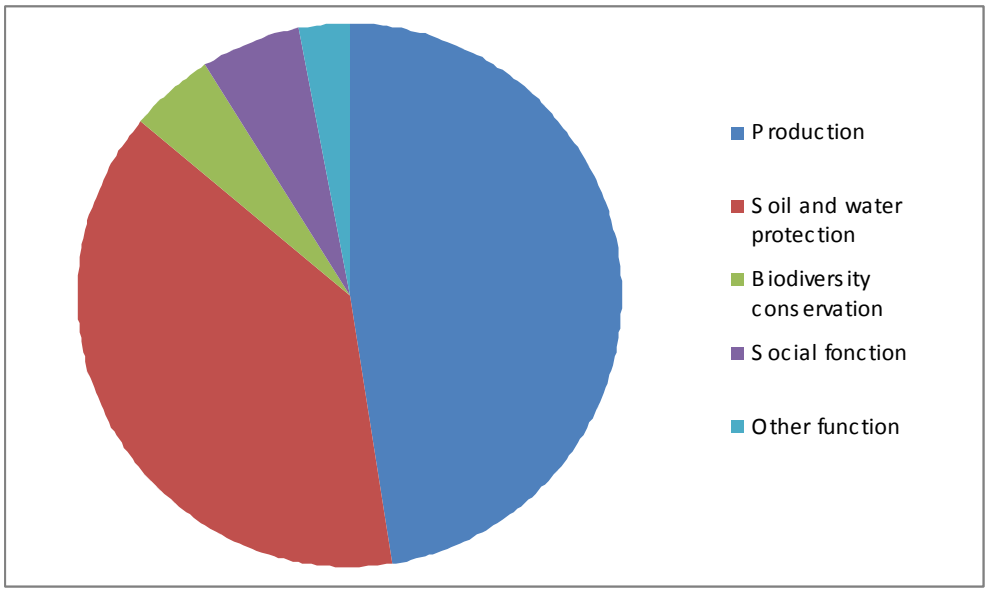


Figure 9 Functional structure of forest surfaces in Romania (%, data source: FAO)

This duality of surface classification induces real appreciation ambiguities of the Romanian forest functions, especially because some areas are recorded as having a dual function. It is not clear what the share of strict protection of the 53% of the functional group I and the one of production is.

It is important that with the integration into the European structures, Romania has aligned itself with the insurance requirements of the protective functions of forest ecosystems. Credit must be given to local or regional initiatives to establish new protected areas, forest parks and national parks, designed to maintain local biodiversity, to protect endemic or rare species and to ensure the vitality of primary forest or the ones that have been insignificantly affected by human intervention.

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