IV. FOREST ECOLOGY AND BIOLOGY

THE EUROPEAN GREEN DEAL AND THE FORESTS IN THE WORLD

Alexander H. Alexandrov, Ivan Iliev

Abstract. The Green Pact of the European Union is part of the United Nations' programme of sustainable development to 2030. To implement this pact, it is necessary to transform the European Union's economy with a view to protect and restore endangered and damaged natural ecosystems, sustainably use resources, and improve people's health status. For this purpose, it has been envisaged to stabilize climate by reducing the emissions of greenhouse gases by 55% up to 2030, as compared with their levels of 1990. Changes are necessary in emission trade, land use and forestry. Forests are particularly important for realizing the Green Pact because of their multi-functionality. The following, most general inferences can be made about the world forests intended to perform their resource-providing, environmental and social functions:

- The world area of forests has continued diminishing in the recent 10 years by 4.7 million ha per year as an average as the rate of forest loss has been abating due to the expansion of the forests in Asia and Europe. The deforestation for the period from 2015 to 2020 occurred at the rate of 2 million ha per year with a trend as to abatement.
- The forests in Africa are the most vulnerable ones, in terms of their area, as their reduction already surpasses that in South America. The deforestation in South America from 2010 to 2020 decreased to the half of that in the period 1990-2000 and 2000-2010.
- Sustainable forest management requires contemporary forest-management planning and forestry but, only for half of their total area there are forest-management plans. This planning activity has been carried out almost completely in Europe only, whereas its proportions in terms of forest area are 2/3 – in Asia, 1/2 – in North and Central America, and only 1/3 – in Oceania, 1/4 – in Africa and 1/6 – in South America. Without total forest-management planning, it is impossible to realize the multi-functional, sustainable management of forests.
- The proportions of forests for harvesting timber and non-timber products, for preservation of the soil and water, for conservation of the biodiversity, and for social benefits and other purposes, in the particular continents, have not been sufficiently well-founded scientifically, hence, the need for optimizing these in congruity with the human needs determined in consideration with the on-going climate changes and the current socioeconomic factors.
- The European Green Deal is, to a certain extent, a continuation of previous policies partly formulated in the last decades of the 20-th century and improved by means of modern philosophy and technology suggesting a new approach to reasonable taking of what is sufficient while harvesting resources.

Keywords: European Green Pact, World forests

During its development, mankind has created various civilizations, including the Sumerian, Egyptian, Assyro-Babylonian, ancient Greek, Roman and Byzantine, around the Mediterranean Sea, the Indian, Chinese, Japanese and Persian, in Asia, the Mexican, Peruvian and other ones, in America, the Polynesian, in Oceania, and other ones.

In the 18th century, the Enlightenment was going on in Europe and it strongly influenced philosophy, art and literature. At present, the European Union suggests a new vision of how to protect the environment, which is called European Green Deal. To a certain extent, it is a continuation of other undertakings of the United Nations Organisation, such as the Stockholm Conference of 1972, the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, and the Conference on Climate, held in Paris in 2015. The European Green Deal was declared on 11 December 2019 by the European Commission.

Changes in climate and in the environment make about one million species extinction-endangered, from the total of eight million ones on our planet. Enormous forestland and oceanic areas are being polluted and destroyed. The resulting problems are global and they cannot be solved within national borders; this is why international co-operation and partnership are necessary.

The Green Pact of the European Union is part of a United Nations' programme of sustainable development to 2030. To implement this pact, it is necessary to transform the European Union's economy with a view to protect and restore endangered and damaged natural ecosystems, sustainably use resources, and improve people's health status. For this purpose, it has been envisaged to stabilize climate by reducing the emissions of greenhouse gases by 55% up to 2030, as compared with their levels of 1990. Changes are necessary in emission trade, land use and forestry; it is also necessary to revise the Energy Taxation Directive (2003/96/EU).

The energy sector has been envisaged to develop mainly by using renewable sources and limiting the utilization of coal by ceasing fossil-fuel subsidies and giving priority to energy effectiveness. About 40% of the generated electric power is consumed in buildings, and it is desirable that this power be from non-polluting sources and at affordable prices [1]. Some branches of economy, such as steelmaking, and chemical and cement industries, are very energy-consuming, and ways of modernizing these should be looked for.

For a 50-year period (1970-2020), the annual extraction of materials in the world increased threefold, hence, circle economy has no alternative. Special attention is necessary to be paid to some resource-consuming sectors, such as construction, electronics, plastic, rubber and other industries, which generate considerable amounts of waste, some of these being hazardous to human health. The problem with waste generation is global and it necessitates that all wastes are collected and recycled separately and their export into other countries is limited.

Obtaining pure hydrogen, creating fuel cells, conserving energy, and capturing and holding carbon dioxide are priority scientific and applied fields.

Transportation (by road, railway, air and water) releases one quarter of the greenhouse gases in the European Union with a trend as to increase, hence, it is envisaged to reduce these within the Union by 90% till 2050. Priority is given to the transportation of loads by railway and water; these loads should amount to 75% of the home ones [1].

It has been envisaged to build, up to 2025, one million points for charging with electricity, or refueling with fuels of zero or low emissions of carbon and nitrogen oxides, 13 million vehicles on European roads. Berthed ships are envisaged to be obliged to use electric power supplied from the dryland [1].

Food production is often related to consumption of large amounts of natural resources, pollution of the soil, water and air, as well as to wasting foods. The European Union has presented a new version of 'From Farm to Fork', which should secure a common agricultural policy with the advancing climate changes with a view to protect the environment while applying biological farming that limits the utilization of fertilizers, pesticides and antibiotics. Healthy nutrition and pure environment will provide higher standard of living for people.

The new strategy for the biological diversity determines particular steps to expanding the

protected dryland and marine territories of great biodiversity.

Climate changes subject forest ecosystems to a considerable pressure, so it is necessary to restore all the forests that are degraded, incinerated, and attacked by pests and diseases; this should be done by forestation, which will contribute to their multi-functionality, fixation of carbon dioxide inclusive.

Freshwater and marine resources are expected to increase the yields of proteins and the generation of renewable energy.

In the current year, the European Commission will revise the financial mechanisms of affecting the environment by making more important the roles of the Innovation and Modernisation Funds, the European Regional Development Fund and the European Social Fund.

Another purpose is to make the financial system more resistant to climatic and environmental risks and damages caused by natural disasters and ecologic catastrophes.

Special attention is paid to research and innovations in the field of pure technologies as 35% of Horizon Europe's budget will be allocated for solving climatic problems [1].

The European Union has the ambition to popularize and initiate the application of sustainable development worldwide, especially in terms of the environment, climate, and power engineering. Adherents to this are the United Nations Organisation and, probably, G-7, G-20, the World Trade Organisation, and some international fora. The G-20 countries comprise a particularly important partner, as they release 80% of the greenhouse gas emissions in the world [1].

The European Green Pact is looking for co-operation with all the countries in all the continents for solving the problems with the global climate and environment with a view to improve the quality of life of the present-day people and their future generations.

Reaching the goals of the European Green Pact is to contribute to improving the environment and people's health and, probably, to mitigating the consequences of climate changes. However, this process requires co-operation and co-ordination with as many countries as possible, from all continents, in order to achieve the desirable global effect.

Contemporary policies in the field of environment are related to the policies in industry, power engineering, transportation and infrastructure, agriculture, animal production, food industries, forestry, regional development, tourism and

healthcare, etc., i.e. these policies depend on a complex of factors of different influences but of a cumulative effect.

Providing pure water and air, high-quality foods, frugal and rational utilization of raw-material resources, improved landscapes, re-cultivation of disturbed terrains, recycling wastes and introduction of circle economy are factors of achieving the goals of the new green pact. The steps taken to environmental protection by only one, though big, state cannot be efficient if these are not co-ordinated at regional and global levels, because such a country will lose some benefits as compared with other countries and will find itself in a situation not equal to theirs. This phenomenon has been defined as 'tragedy of the commons'.

Some national sectors of industry and power engineering, which are energy-consuming or release many greenhouse gases, will need reconstruction requiring large investments. Such investments could appear to be unaffordable to poorer countries and will probably need longer gratis periods. At the same time, however, the Green Deal could be a catalyst of innovations in economy, and of new technologies for protecting nature, and this is a winning move in the long run.

In more summarized forms, the following recommendations could be made:

- Every country needs to develop a clear strategical vision of the environment and the related strategical goals. It is desirable to formulate the vision and goals as a result of a consensus of all stakeholders.

- The sectoral policy in terms of the environment should be co-ordinated with the other sectoral policies at national, regional and global levels.

Forests are particularly important for realizing the Green Pact because of their multi-functionality.

Their functions have been differentiated into three categories: economic (or commercial), ecological (or environmental) and social; the first category also includes the resource-providing functions, namely the production of timber, non-timber products such as herbs, mushrooms, forest fruits, resin, tannins, bee honey, etc., including game meat. For centuries on end, these have been considered primary because people's way of life has directly been dependent on them.

It was not before the recent decades when, under the conditions of enhancing environmental crisis, the mankind started considering forests not only a source of timber but also one of the main climate-regulating and environment-forming factors on our planet – important condition of all-human security and a guarantee of the survival of mankind. The social and environmental functions of forests are considered equal to and even exceeding the resource-providing ones and are defined as the main factors of the formation and preservation of nature. The state of forests is indicative of the quality of life, and the consumption of timber and other forest products increases permanently [2].

The total forest area in the world amounts to 4.06 billion hectares (ha). In other words, it occupies 31% of the dryland, which means that there are 0.52 ha of forest per capita. Depending on the climatic peculiarities according to geographic zones, forests are generally subdivided into tropical (45%), boreal (27%), temperate-zone (16%) and subtropical (11%). Their distribution according to continents and countries is rather uneven. The leader in terms of forest area is Europe, next followed by South America, North America, Africa, Asia and Oceania, as this arrangement remained unchanged during the 1990-2020 period (Table 1) [3].

Table 1. Forest Area in Million ha according to Years

Continents	1990	2000	2010	2020	%
Europe	994	1,002	1,014	1,017	25
South America	974	923	870	844	21
North and Central America	755	752	754	753	18
Africa	743	710	676	637	16
Asia	585	588	611	623	15
Oceania	185	183	181	185	5
Globally	4,236	4,158	4,106	4,059	100

Arranging the countries according to their forest areas is as follows: The Russian Federation – 815 million ha (20.1%), Brazil – 497 million ha (12.2%), Canada – 347 million ha (8.6%), the USA – 310 million ha (7.6%), China – 220 million ha (5.4%), i.e. These five states totally possess 2,189

million ha (53.9%) of forest areas, whereas the rest of them – a total of 1,870 million ha (46.1%) (3). In the recent 30 years, the world has lost 176 million ha of forests; these forests show a trend as to diminution (Table 2).

Table 2. The Change of Forest Area in Million ha according to Decades (1990-2000)

Continents	1990-2000	2000-2010	2010-2020	1990-2020
Asia	+2	+24	+12	+38
Europe	+8	+12	+3	+23
Oceania	-2	-2	+4	0
North and Central America	-3	+2	-1	-2
Africa	-33	-34	-39	-106
South America	-51	-52	-26	-129
Globally	-79	-50	-47	-176

During that period, the forest area increased in two continents only: Asia, by 38 million ha, and Europe – by 23 million ha, whereas in North and Central America it was insignificantly reduced by 2 million ha, but the diminution of forests was drastic in Africa – by 106 million ha, and in South America – by 129 million ha. The decrease in the forest area in Africa, expressed in percentage, was greater than in South America; besides, this trend was more unfavourable to Africa. This circumstance requires urgent steps to limiting the deforestation of Africa and South America to be respectively taken by the states having strong anthropogenic effects on their forests. Positive trends as to increase in the forest areas in the recent 10 years (2010-2020) according to countries have been observed in China, Australia, India, Chili and Vietnam, next followed by Turkey, the USA, France Italy and Romania.

There are still 1.1 billion ha of primary forests in the world, 28.2% of these being in North and Central America, 26.9% in South America, 23.4% in Europe, 13.5% in Africa, 7.8% in Asia and 0.2% in Oceania. About 60% of the primary forests are in the Russian Federation, Brazil and Canada. Since 1990, the total area of the primary forests has decreased by 81 million ha; the greatest decrease being in South America – by 43 million ha, Africa – by 20 million ha, Asia – by 14 million ha, very strongly expressed during the recent decade. Only in Europe has been an increase in the total area of primary forests by 553 000 ha.

By 2020, 93% of the forests in the world were natural, i.e. forests that regenerate in a natural way, as their percentage incessantly diminished during the 1990-2020 period, and only in Europe a slight trend as to an increase was observed (Table 3) [3].

Table 3. Naturally Regenerated Forests in Million ha according to Years

Continents	1990	2000	2010	2020	%
South America	966	913	855	824	22
Europe	913	913	914	915	24
Africa	734	701	665	625	17
North and Central America	732	720	714	706	19
Asia	511	493	491	487	13
Oceania	182	179	176	180	5
Globally	4,038	3,919	3,815	3,737	100

The planted forests worldwide occupied in 2020 7% of the total forest area and during the past 30-year period they showed a trend as to a quick increase (Table 4) [3]. Their distribution according to areas is now as follows: in Asia – 135 million ha,

in Europe – 74 million ha, in North and Central America – 47 million ha, in South America – 20 million ha, in Africa – 11 million ha and in Oceania – 5 million ha.

Table 4. Planted Forests in Million ha according to Years

Continents	1990	2000	2010	2020	%
Asia	74	94	120	135	46
Europe	54	62	72	74	25
North and Central America	23	33	41	47	16
South America	7	9	15	20	7
Africa	9	9	10	11	4
Oceania	3	4	4	5	2
Globally	170	211	262	292	100

About half of the planted forests are plantations (large forests to produce wood) – 131 million ha, the most of these being in Asia – 79 million ha, and South America – 20 million ha. They comprise 99% of the forestations and 2% of the total forest area in these continents. The least amount of plantations

occurs in Europe – 4.5 million ha, comprising 6% of its forestations and 0.4% of its forest area [3]. As indigenous so introduced forest tree species are used in the plantations, but their percentages according to continents vary too much (Table 5).

Table 5. Percentages of Indigenous and Introduced Forest Tree Species in Plantations according to Continents in 2020

Continents	Indigenous Species %	Introduced Species %
North and Central America	96	4
Asia	68	32
Africa	30	70
Europe	22	78
Oceania	22	78
South America	3	97
Globally	56	44

The highest percentages of indigenous forest tree species are used in the plantations in North and Central America (96%) and Asia (68%); considerably lesser are these percentages in Africa, Europe and Oceania (30%, 22% and 22%, respectively), and they are quite negligible in South America – a total of 3%. The percentages of the introduced species are just the opposite. Globally, the indigenous species in plantations exceed the introduced ones by 12%.

In order to preserve forest ecosystems, protected territories have been differentiated; these include 726 million ha of forests (18% of the world forest area). The percentages of forests in the protected territories according to continents in the descending order are: South America – 31%, Africa – 27%, Asia – 25%, Oceania – 16%, North and Central America – 11% and Europe – 6% of their forest area, respectively.

Forest-management planning is a substantial indicator of how forests are managed. The total area of world forests that have forest-management plans permanently increases and, in the recent two decades, it reached, from 233 million ha (6%) in 2000, 2.05 billion ha (51%) in 2020.

This process has been very uneven with the particular continents; Europe being the leader with 96% of forests of planned management, next followed by Asia – 64%, North and Central America – 59%, Oceania – 31%, Africa – 24% and South America – only 17%. This means that in all the continents and the states therein a large amount of forest-management planning is yet to be done, and it needs respectively prepared specialists, considerable

funding and good organisation according to places and times.

Due to reduction of the forest area on our planet, the volume of the world growing stock of forest trees has slightly diminished – from 560 billion m³ in 1990 down to 556 billion m³ in 2020. At present, this growing stock has been distributed according to continents as follows: South America – 187 billion m³, Europe – 116 billion m³, North and Central America – 95 billion m³, Africa – 76 billion m³, Asia – 63 billion m³ and Oceania – 19 billion m³. During the 1990-2000 period, a trend has been observed as to diminution of the growing stock in South America and Africa and increase of this stock in Europe, Asia, and North and Central America (Table 6) [3].

Table 6. Volume of the Growing Stock of Forest Trees in Billion m³ according to Continents

Continents/Years	1990	2000	2010	2020	%
South America	207	199	191	187	34
Europe	104	108	113	116	21
North and Central America	90	92	93	95	17
Africa	88	84	81	76	14
Asia	52	54	58	63	11
Oceania	19	19	19	19	3
Globally	560	556	555	556	100

The five countries whose growing stocks are the largest are Brazil – 120 billion m³, the Russian Federation – 81 billion m³, Canada – 45 billion m³, the USA – 41 billion m³ and Congo – 31 billion m³ or totally – 318 billion m³, which is 57% of the growing stock of forest trees in the world.

At the same time, the growing stock per unit of area increased from 132 m³/ha, in 1990, up to 137 m³/ha, in 2020, as it was the largest in South America – 222 m³/ha, next followed by North and Central America – 126 m³/ha, Africa – 120 /ha, Europe – 114 m³/ha, Oceania – 102 m³/ha and Asia – 100 m³/ha.

The forests in the world contain a total of 606 gigatons (the tons are metric) of living biomass (149.3 tons/ha) and 59 gigatons of dead-wood stock (14.5 tons/ha). The living biomass according to continents is in the following order: South America – 198 gigatons (235.2 tons/ha), Europe – 110 gigatons (107.9 tons/ha), Africa – 107 gigatons (168 tons/ha), North and Central America – 84 gigatons (111.1 tons/ha), Asia – 79 gigatons (126.5 tons/ha) and Oceania – 28 gigatons (152.6 tons/ha) [3].

The total amount of carbon in the world forests decreased from 668 gigatons in 1990 down to 662 gigatons in 2020. Of it, 299 gigatons were in the soil, 295 gigatons – in the living biomass and 68 gigatons – in the dead wood and the litter. At the same time, a slight increase in carbon density was noticed: from 159 tons/ha in 1990 up to 163.1 tons/ha in 2020; 73.8 tons/ha were in the soil, 72.6 tons/ha in the living biomass and 16.7 tons/ha – in the dead wood and the litter. The amount of carbon has currently been distributed according to continents like this: Europe – 172 gigatons (169.5 tons/ha), North and Central America – 146 gigatons (194.1 tons/ha), Africa – 81 gigatons (127.1 tons/ha) and Oceania – 33 gigatons (178.5 tons/ha) [3].

About 1.14 billion ha (28%) of the world forests are mainly managed for harvesting timber and non-timber products, and other 749 million ha (18%) are intended for multipurpose utilization.

In the world, 424 million ha of forests (11%) are mainly intended for conservation of the biodiversity therein. Of these forests, 106 million ha are in Europe, 89 million ha – in Asia, 84 million ha – in South

America, 75 million ha – in North and Central America, 39 million ha – in Africa and 31 million ha – in Oceania.

Besides, 186 million ha of the forests in the world (6%) are intended for social benefits, such as recreation, tourism, training, research, and preservation of cultural and spiritual places. The leader in terms of the total area of such places is South America – 140 million ha, next followed by Europe – 19 million ha, North America – 18 million ha, Asia – 6 million ha and Africa – 3 million ha [3].

The natural disasters occurring in forests are caused mainly by forest fires, storms, insect pests, and diseases. The worst scourge is the fires, which destroy not only forests but also settlements, farm crops, pasture grounds, and animals. During the 2001-2018 period, in the world were damaged by fires 7.2 billion ha, including savannas and pasture grounds, 65% of the latter two categories being in Africa.

The incinerated forests comprised 3% of the world forest area in 2015, as in the tropical forests this area was 4%, in the subtropical ones – 2%, and 1% was as in the temperate-zone so in the boreal forests.

Insects damaged 1.4% of the world forest area in 2015. The respective percentages in some of the continents are: Asia – 3%, North and Central America – 2.7%, Africa – 1.0%, South America – 0.2% and Europe – 0.1%.

The diseases of the forests in the world in 2015 affected 0.4% of their total area: in North and Central America – 1.0%, in Africa – 0.8%, in each of Asia and Oceania – 0.6%, in South America – 0.4% and in Europe – 0.1%.

The forests affected by natural disasters, such as tornados, windthrows, wind breakages, snowthrows and snow breakages, on the whole planet amounted in 2015 to a total area of 3%: 1.1% in Africa, 0.6% in Asia, 0.5% in North and Central America, 0.3% in South America and 0.1% in Europe [3].

The above data definitely show that the forests in Europe have the best health status as compared with those in the other continents. To a certain extent, this is because Europe is the cradle of forestry and has sylvicultural traditions.

The yield of wood in the world in 2018 was 3,971 million m³, 1,161 million of these being in Asia, 824 million – in Europe, 779 million – in Africa, 691 million – in North and Central America, 429 million – in South America and 87 million – in Oceania. In that same year, the states with the highest yields of wood were: the USA – 11%, India and China – 9% each,

Brazil – 7%, the Russian Federation – 6%, Canada – 4% and Indonesia – 3%.

The non-timber products obtained in the world in 2015 have a total monetary worth of \$ 7.71 billion. Of this sum, 37% is the worth of nutritive plants, 22% – of ornamental ones, 22% of game meat, 9% – of bee honey and wax, 7% – of medicinal and aromatic products, 5% – of resins and rubber, 3% – of colouring agents, and 14% – of other ones [3].

In conclusion, the following, most general inferences can be made about the world forests intended to perform their resource-providing, environmental and social functions:

- The world area of forests has continued diminishing in the recent 10 years by 4.7 million ha per year as an average as the rate of forest loss has been abating due to the expansion of the forests in Asia and Europe. The deforestation for the period from 2015 to 2020 occurred at the rate of 2 million ha per year with a trend as to abatement.

- The forests in Africa are the most vulnerable ones, in terms of their area, as their reduction already surpasses that in South America. The deforestation in South America from 2010 to 2020 decreased to the half of that in the periods 1990-2000 and 2000-2010.

- Sustainable forest management requires contemporary forest-management planning and forestry but, unfortunately, only for half of their total area there are forest-management plans. This planning activity has been carried out almost completely in Europe only, whereas its proportions in terms of forest areas are 2/3 – in Asia, 1/2 – in North and Central America, and only 1/3 – in Oceania, 1/4 – in Africa and 1/6 – in South America. Without total forest-management planning, it is impossible to realize the multi-functional, sustainable management of forests.

- The proportions of the forests for harvesting timber and non-timber products, for preservation of the soil and water, for conservation of the biodiversity, and for social benefits and other purposes, in the particular continents, have not been sufficiently well-founded scientifically, hence, the need for optimizing these in congruity with the human needs determined in consideration with the on-going climate changes and the current socioeconomic factors.

- The European Green Deal is, to a certain extent, a continuation of the previous policies partly formulated in the last decades of the 20th century and improved by means of modern philosophy and technology suggesting a new

approach to reasonable taking of what is sufficient while harvesting resources, namely forests with their economic, environmental and social functions.

REFERENCES

1. European Commission, 2019. The European Green Deal. Communication from the Commission to the European Parliament, the European Council, the European Economic and Social Committee and the Committee of the Regions, Brussels, p. 24.

2. Naydenov, Y. and A. Alexandrov, 2020. Ecological, Social and Economic Functions of Forests. Prof. Marin Drinov Publishing House of the Bulgarian Academy of Sciences, Sofia, p. 155

3. FAO, 2020. Global Forest Resources Assessment 2020. Main Report, Rome, p. 184

4. Alexandrov, A. 2017. The World Forest Resources. – Ecological Engineering and Environment Protection, Issue 3, pp. 60-63.

Prof. Alexander H. Alexandrov, DSc.

Department of Agriculture and Forestry
Bulgarian Academy of Sciences,
15 November str. 1,
1040 Sofia
E-mail: alexandrov_38@abv.bg

Prof. Ivan A. Iliev, DSc.

University of Forestry,
10 Kliment Ohridski blvd.,
1797 Sofia, Bulgaria