Chapter 13
Forest Cover for the Safety of Biosphere and Environment

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13.1 Introduction

Nowadays, one of the main concerns of the world society is the anomaly of cataclysmic processes caused by global warming on our planet, which has resulted in increasing catastrophic disastrous events leading to large destructions and casualties. In addition, with increase in population, predicted to be 11 billion in 2050, demand for food, water, housing, energy, and mobile equipment and other requirements will increase. The occupation of forest areas and irrational cutting of trees leads to a reduction in the photosynthetic process, increasing heat from the sun beams, which cause all leading to global warming, and reduce in oxygen, together with the emergence of new viral, bacterial, and chronic diseases.

In the twenty-first century the temperature on Earth is expected to increase, which will lead to the melting of Antarctic and Greenland ice caps, followed by a sharp rise of the world's ocean level, flooding the coastlines in many countries, leading to large economic and social shocks, loss of crops, deficit of drinking water, storms, and coastal erosion. Since climate change is global, it is necessary to find ways to solve this problem through joint efforts on an international level (Imanberdieva et al. 2018).

Currently, for biosphere and environmental protection, for softening the climate change process for all countries in the world, most important task is to carry out protective activities. First of these is the rational use of natural resources, ensuring the sustainability of environmental and ecological balance. It is worth mentioning that for climate change regulations, stabilization of oxygen balance and the maintenance of biodiversity are of particular importance, and the forests are leading in this connection.

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13.2 Biosphere

It is a combination of live and nonmotile substances in dynamic equilibrium, where the living organism transforms this environment in accordance with its demands. The history of the development of biosphere is 2.5–3 billion years old. During this time, living organisms have been developing under different environmental conditions. Some single-celled seaweeds and bacteria grow in hot water springs of up to 75–100 °C and others at minus 6–7 °C and mushroom spores can endure 120–180 °C (Miqadze 2006). Thus, the biosphere is the layer of the Earth where life exists and develops. It covers the hydrosphere, lithosphere, and atmosphere. The hydrosphere is an aqueous layer of the Earth. The oceans cover 7/10 of the Earth's surface. It is used by living organisms up to 100–200 m depth, where the sunbeams can reach. Only bacteria can live deeper. The lithosphere is a thick layer, where life is up to a few tens of centimeters. Some organisms live in 2–3 km depth depending on the conditions of the land and 1–2 km from the bottom of the ocean. The simplest anaerobic bacteria live in an underground watershed and oil-containing horizons at a depth of 3–5 km. The biosphere is a combination of plants, animals, microorganisms, and nonliving components of the environment. The main biomes of the biosphere are the land, sea, and freshwater (Dre 1976). Its upper boundary reaches 6 km in the atmosphere, where chlorophyllous plants grow. Some arthropods live above that are nourished by the plant dust, spores, and microorganisms brought by the wind (Eliava et al. 1992).

About 600 million years ago, the lowest autotrophic plants emerged, 500 million years ago – plants and insects, and 350 million years ago – angiosperms and mammals. The development of plants containing chlorophyll on the ground along with the increase of oxygen contributed to the formation of soils. Later, with the increased amount of oxygen, a variety of flora and fauna, including humans, have developed on Earth. The existence of biosphere before human origin is called biogenesis, while the developmental stage of society is called noogenesis. At present, there are about 2 million species of plants and animals. The animal species are up to 1.5 million. Among the plants, angiosperms with over 300,000 species occupy the first place followed by mushrooms which are about 100,000 in number. Out of the number of animal species, the insects occupy the first place with 1 million taxa followed by mollusks with about 100,000 taxa followed by the vertebrates with about 50,000 taxa (Qajaia 2008).

13.3 Atmosphere

The atmosphere comprises the Earth's surrounding gases together with water vapor and dust. According to the strata, the individual layers are troposphere (thickness 8–18 km), stratosphere (55–60 km), mesosphere (80–85 km), thermosphere (80–1000 km), and above that lies the exosphere.

In the troposphere, atmospheric air mass is 90% with 4% to 0.5% water vapor, which extends up to 8–10 km at the poles and 16–18 km at the equator. Here, the air

temperature decreases by 5 °C at every kilometer height. This layer entirely passes short-wavelength solar radiation and detects the Earth's long-wavelength radiation.

The stratosphere represents 40–60-km-thick layer above the troposphere. Here, the air is dry and rare; temperature rises from the bottom upward in the summer from 0 to 15 °C and in winter from −10 to −5 °C (Qajaia 2008). In the layer of the atmosphere at the height of 20–30 km, there is a variety of oxygen gas – ozone which absorbs a large portion of the ultraviolet radiation coming from the sun. It can destroy living organisms. So the ozone layer is considered to be the protective shield of the biosphere in the Earth (Budiko 1965).

The mesosphere is a 20–25-km-thick layer, where temperatures in summer fall to −80 °C and in winter −100 °C. Because of the strong turbulent movement, wind speed exceeds 50–100 km/h.

The temperature starting from a height of 80 km in the thermosphere increases by 5 °C per 1 km and above 1000 km reaches 2000 °C. Anything including meteors run here at a speed of 100–130 km/h burning down a mesosphere which is located at a depth of about 80 km.

The exosphere extends to thousands of kilometers, where temperature rises by 1 °C per 1 km; here spacecraft are flying and radio communication is possible.

Near the surface of the Earth, dry air composition consists of 78% nitrogen, 21% oxygen, 10^{-6} ozone, 0.9% argon, 0.03% carbon dioxide, and 0.1% other gases. This composition of the air does not change up to 90–100 km in the atmosphere and is called the homosphere. About 200 km above the main part of the air is nitrogen, from 600 km helium, and above 2000 km the hydrogen.

The atmosphere holds part of the space beams and the majority of meteorites. Only 48% of solar radiation reaches the Earth. If there was no atmosphere, the average temperature of the air on the surface of the Earth would be 23 °C, not 15 °C (Miqadze 2006). Almost half of the radiating energy on our planet is spent on evaporation of water, and this water returns to the Earth as precipitation.

13.4 Forests and Life on Earth

At the start our planet, the atmosphere lacking in oxygen but was rich in carbon dioxide, methane, and nitrogen compounds. Nearly 3 billion years ago, the first living organisms on the Earth were created at the bottom of the non-deep parts of the hydrosphere, where the sunbeams and warmth were reaching. Such conditions are near the tropical belt where with the carbon dioxide absorbed by the plant's chlorophyll and from the weather with the help of solar energy, carbohydrates are synthesized and free oxygen is released. This process is called photosynthesis, or production of organic substances from the inorganic components of the environment via green plants. Schematically it looks like this (Qajaia 2008):

$$6CO_2 + 6H_2O \xrightarrow[\text{Green plants}]{\text{Sun's radiation energy}} C_6H_2O_6 + 6O_2 \tag{13.1}$$

Here, carbon dioxide and water molecules are diluted and the combination of glucose molecules is formed during this process, and then the free oxygen is released.

The first species of the earliest times were the blue-green seaweeds, which transformed the solar energy into chemical energy, thus contributing in the growth and development of plants. Scientists estimate that over a year, there are more than 10 billion kcal of solar radiation per 1 Ha on Earth, which is used by the plants for photosynthesis (Budiko 1965). Every year, with the solar effect, about 83 billion tons of organic substances are formed on the Earth, and 53 billion tons are created on land and the rest in marine environments. It is noteworthy that plants accumulate only 0.3% of solar energy. The quantity of carbon dioxide in the atmosphere is reduced to 0.03% due to photosynthesis, and the number of free oxygen increases to 21% or 1000 times (Qajaia 2008).

According to Ramad (1981), 2 billion years ago, the first organisms emerged and these were able to carry out photosynthesis (prokaryotes: blue-green plants, bacteria, viruses), and after 0.5 billion years, the highest organisms (eukaryotes) emerged. Nearly 1 billion year ago, the oxygen content in the atmosphere constituted 1% of the present. Phytoplanktons increased, and as a result of photosynthetic intensity, atmospheric ozone was created, which stopped the adverse effect of ultraviolet light from the sun. This contributed to the development of the first organic world in the upper layers of water and then on land. Millions of years later, various species of plants developed which were the primary products for animal and human nutrition (Dre 1976). The vegetation of the Earth annually assimilates around 5×0^{10} tons of carbon or absorbs 1.8×10^{11} tons of carbon dioxide, decomposes 1.3×10^{11} tons of water, separates 1.2×10^{11} tons of molecular oxygen, and gathers 4×10^{17} kcal of solar energy (Eliava et al. 1992).

It is estimated that 50–60% of oxygen is released by land vegetation and the rest by the phytoplanktons. One hectare of forest in 1 h absorbs so much carbon dioxide as 200 people breath out in 1 h. During 1 year, 1 ha of mixed forest absorbs 15 tons of carbon dioxide and releases 13 tons of oxygen. The use of oxygen by humans depends on the physiological condition of his body, age, weight, and sex. In medicine, it is known that the person in a waiting period in 1 min spends 0.35–0.40 liters of oxygen and 5 l/min during work. A person needs 500–600 liters of oxygen in a day; therefore, a forest area per person should consist of at least 0.3 ha (Dre 1976).

Although trees are less than 1% of all plant species, they form almost 90% of land phytosome and 64% of its productivity (Miqadze 2006). So, the vegetation cover is the source of oxygen, food, and energy. Therefore, the existence of humans and animals depends on the condition of the forest cover. In the Bible, it is known that God during the seven-day cycle of creation of universe; among many wonders; on the third day forests were created. By doing so, he defined the right to use the timber. But the forest is ruined unmercifully by people for the last hundreds of years (Basilashvili 2016a).

13.5 Climate and Global Warming

Global warming is the process of the fastest growth of average annual temperatures in the Earth's atmosphere. Scientists are presenting two different versions for this situation. According to the first version, it is a periodically repetitive natural cataclysm of solar activity, determined at 11-, 22-, and 80–90-year periodical (Glaisberg) changes. The current global warming is likely associated with a higher rate of sunlight, which can be changed via reduction. In the second version, the warming in the Earth is because of human anthropogenic activities. These include the heat radiation containment, reflected from the Earth by the gases which expand in the atmosphere. From such gases, it is noteworthy that carbon dioxide, methane, nitrogen monoxide, ozone, and Freons (hydrocarbon halogen) freely pass solar beams on the Earth but hold the heat reflected by it (Tkemaladze 2015).

From 1880 to 1930, the average annual air temperature has increased by 0.5 °C. Since 1940, the increase in temperature has changed, and since 1960s, an intensive growth of temperature has begun on Earth (Elizbarashvili et al. 2013; Imanberdieva et al. 2018). Following the techniques developed during last 1.5 years, the amount of carbon dioxide (CO_2) appears to have increased in the atmosphere by 1/3, and methane by 2.5 times, which excites the Earth 20–25 times more, rather than carbon dioxide. The increase of methane is associated with pipelines and leakage from bogs and livestock. Methane is formed by means of special bacteria in the stomach of the livestock. From the dung, methane is released which is used for fuel. 1.5 billion cows living on the planet allocate 18% of the greenhouse gases, which exceeds all types of transport systems. That is why the eco-activists of the world propagate the vegetarian diet and claim that if there is no livestock, there will be no problems. A third of the methane in the atmosphere is created by the livestock (Buchkovska et al. 2015; Imanberdieva et al. 2018).

The increase in carbon dioxide is associated with the development of industry, as well as wood and coal burning. Every year humans burn 4.5 billion tons of coal and 3.2 billion tons of oil, gas, peat, and other fuels. The concentration of carbon dioxide increases especially with cars and aircraft fumes. The main source of harmful substances is outdated transport and the suspicious quality of their fuel.

Nearly 27 billion tons of carbon dioxide is estimated to enter the Earth's atmosphere annually through industrial activity. Its concentration in the atmosphere has grown up to 38%, where 30% is absorbed by the world's oceans, 13% by biosphere, and soil, 57% remains in the atmosphere, which contributes toward an increase in the global warming. From the beginning of the industrial era, the atmosphere has accumulated 770 billion anthropogenic carbon dioxide (Barkalaia et al. 2015; Imanberdieva et al. 2018).

As a result of photosynthesis, 1 ha of forests absorbs 5–10 tons of carbon dioxide and releases 10–20 t of oxygen. The thermal energy of solar radiation falls on Earth every year, and it is estimated to be on 1 ha area of 10 billion kcal, 93.8% of which is absorbed by the green cover (Aress 1982).

The excessive amount of harmful gases added by anthropogenic activities expands the ozone layers in the atmosphere, which is a very dangerous phenomenon for living organisms and is directly related to global warming. These processes are further enhanced when people use various technologies in the space. It is estimated that launching space missiles causes damage and disruption of the ozone layer, which will lead to increased solar radiation and temperature.

13.6 Ozone Layer and Its Change

Ozone is blue air and its molecule consists of three atoms of oxygen (O_3). It occurs when the ultraviolet radiation of the sun affects the oxygen molecule, leading it to collapse into atoms, and oxygen atoms are linked to the oxygen molecule (Zhorzholiani and Gorgadze 2008):

$$O + O_2 = O_3 \tag{13.2}$$

There is "bad ozone" and "good ozone." Scientists call the "bad ozone" photochemical smoke, which is located in the lowest layer of the atmosphere in the troposphere. Under certain concentrations, it is dangerous for human health: irritates the upper respiratory tract and causes vegetative disturbances, pulmonary edema, dizziness, eye cataracts, etc. Such "bad ozone" is only 10% of the Earth's ozone, and the remaining 90% is good ozone.

"Good ozone" is located in the stratosphere and protects the Earth from the devastating impact of ultraviolet radiation. Ozone content is variable at different altitudes. Sixty percent of it comes from the layer that is situated 16 km to 32 km, and the maximum concentration is at approximately 25 km. There is a 3.5-mm-thick protective ozone layer on our Earth that makes the planet more suitable for our existence. The amount of ozone in the stratosphere depends on the geographical range, the height of the distance from the Earth's surface, and the time of year. The effects of solar radiation and oxygen, nitrogen, hydrogen, chlorine, and bromine cause the dissolution of the ozone molecule and the ozone layer. The main reason for this is the fact that many chemical compounds are used in household and agriculture, especially Freons ($CFCL_3$ and $CFCL_2$), which were previously used successfully in refrigerators and air conditioners.

As a result, the ozone layer has got reduced twice its content in many parts of the world. In the Arctic in summers and above the Antarctic in winters, some holes have been detected. The subsequent degradation of the ozone layer facilitates the penetration of ultraviolet radiation into the atmosphere that dramatically affects living organisms and causes climatic anomalies and natural disasters. In 1996, factories of ozone disbanding substances (Freons) were closed, resulting in a reduction in the ozone hole by 34% in 2014, and this hole is expected to get reduced by 10% by 2020. By 2030, the ozone layer will be filled in the Northern Hemisphere, by 2040 in the Southern Hemisphere, and by 2050 at the Earth's poles. It is noteworthy that since the 1950s of the twentieth century, space has accumulated a

lot of cosmic trash, which comprises 25,000 items of various sizes ranging from the smallest particles to the total spacecraft. They are moving about 25,000 km/h speed and their collision with any moving spacecraft can cause a huge catastrophe.

13.7 Forests: Importance and Impacts

The forest is a vital component of the biosphere and represents a complex combination of ecosystems of trees, bushes, and herbs, animals, birds, and microorganisms that are interconnected in their developmental process and affect both the environment and each other (Ozturk et al. 2010; Karahan et al. 2015; Altay 2019; Rajpar et al. 2020). A forest has substantial impact on the processes that are occurring in the atmosphere, on the surface of the Earth, and below its depths. The forest cover participates in the support of different activities. It plays an important role in economic activity and is a source of raw material, which is widely used in different industries (Karahan et al. 2015). The timber is used both as building material and fuel (Ozturk et al. 2017). It also provides food and medicinal products, paper, cardboard, furniture, and parquet. Fifteen thousand types of products are made from trees, so the increase in the world's population and technical progress are the reasons demand for forest resources incredibly increases.

13.7.1 Forests and Climate Interactions

The importance of forest is first revealed in the regulation of air elements (air temperature, humidity, air currents, and speed). All these affect human health. For example, in summer, temperatures in the treeless areas are 3–5 times higher, which results in the acceleration of human pulse, overheating of the body, and decrease of labor ability. Dry air is also harmful in areas where there is lack of forest as it causes mouth, throat, and nose dryness and deterioration of antiinfective capacities. The high speed of wind in treeless areas has a negative impact on breathing, blood circulation, and the nervous system. The most comfortable conditions for people to relax and rejuvenate are created by the forests. Besides, the beauty and attractiveness of the natural landscapes of forests have a positive impact on the mental condition of humans, improvement of mood, restoration of labor skills, and spiritual conditions.

13.7.2 Sanitary-Hygienic Role of Forest

In the cities, industrial centers and other settlements, the atmosphere is systematically being polluted by harmful chemical contaminants. In this environment; for the protection and improvement of the sanitary and hygienic standards; the greatest role is played by the forests, where almost all forest tree absorb emissions as these

possess aromatic essential substances like phytocides, which add to the disappearance of many microbes and viruses, thus cleaning and making the air healthier. In general, bacteria and microbes are reduced in the woods. 1 m^3 of air contains up to 500 pathogenic bacteria, while 1 m^3 of air in the city has 36,000 bacteria. It is estimated that land vegetation annually releases 175 million tons of aromatic oils, which protect us (Kandelaki 2013).

13.7.3 Forest as a Filter

The lower layers of the atmosphere in our era, except carbon dioxide, are systematically polluted by harmful chemical and mechanical additions. Dust reduces the sun's ultraviolet radiation and air transparency and changes the level of ionization. A person breathes 20 m^3 of air overnight, and if the air is dusty, it causes several illnesses like; asthma, nasal mucosal atrophy and few others. Forest is the strong air filter from dust. It is estimated that 1 ha of forest every year filters 50–70 tons of dust. 1 ha area of beech copse filters about 68 tons of dust; oak copse, 56 t; pine copse, 36 t; and spruce copse, 32 t (Kandelaki 2013).

13.7.4 Forests and Technogenic Pollution

Today, a large scale of technological applications have caused an accumulation of harmful chemical substances in our environment. Contamination of air, water, and soil with different substances has reached a level that threatened the many regions of the living world, including forests, and degradation of massive forests has started. Experiments have revealed that plants have the ability to remove pollutants from air and can serve in detoxification. Oleaster, ash tree, acacia, oak, plane tree, maple, and willow are distinguished for having resistance against harmful gases, but the pine cannot stand them, that is why it is damaged.

13.7.5 Forest and Noise

The forests absorb various kinds of noise, depending on the composition, structure, frequency, and their mixed composition. Multistory high-frequency copse is characterized by high noise absorption. For example, a tree with high radius (0.8 m) which is 80–100 m away from the source of noise (highway) reduces the level to 30 decibels in the forest copse.

13.7.6 Forest and Yield

The forests have a great influence on the cultivation of agricultural crops. A forest cover increases yield by 20–25% (Armand 1964), which clearly indicates the importance of forests. Each hectare of forest strip protects on an average 30–40 hectares of the field, from which the grain yield increases with 2–3 centner per hectares. Such protected areas can additionally add 60–80 centner of crops and 8–10 years after the expenses incurred on the construction of forest stripes will be fully compensated. The impact of forest stripes is particularly pronounced in the months leading to drought. "The forest produces water, the water produces a harvest, and the harvest produces life."

13.7.7 Water Management and Soil Protection with Forest

Part of the atmospheric precipitation falling on the land surface enters the soil which feeds the rivers all year round. The higher is the seepage in the river, the less is the flood and erosion of soil. Therefore, forests also perform watershed and protective functions. In this regard, the importance of forest is huge in mountainous areas where there are many other defensive features added to the multilateral purposes of the forest. The forest in the mountains regulates the flow of rivers. The high frequency (>0.8) of mountain forest is the main factor that facilitates the transfer of atmospheric precipitations to the depths of soil, thus regulating the liquid surface runoff, improving the water balance, and protecting the rivers from drying (Kharaishvili 2001). The forests mainly protect the inhabited areas and populations, roads, fields, and soils from dangerous disasters such as floods, mudflows, landslides, avalanches, erosion, etc.

13.8 World Forests

13.8.1 Past

The oldest vegetation cover is found in Australia, said to be approximately 395 million years old. About 370 million years ago, vegetation was in the form of bushes. Primary forests were low. The tallest trees were 7.5 m, and these were the primitive ferns. 345 million years ago, the Stone Age began, when dense, wide forests were present on Earth with 30-meter tall trees and primitive plants with seeds. During the dry climate 280 million years ago, primitive conifers appeared and got widely distributed.

Sequoia trees and floral seed plants are present there from over 225 million years. 135–165 million years ago, the ancestors of modern rubber trees, magnolias, oaks, willows, and maples were dominating the Earth. During the Paleogene period, Northern Hemisphere forests were similar to modern tropical and moderate belts of forests. In the north, there was arctic-type flora. In the Tertiary, the tropical flora spread near the equator.

During the dry climate of the Neogene period, forests decreased and the herbaceous vegetation dominated, followed by the dominance of coniferous plants. The Quaternary period began 1.8 million years ago and is still going on. The peculiarity of this period is the alternation of the ice ages with warm glacial intervals. Because of this, the forest areas have got reduced everywhere.

13.8.2 Forests in the Epoch of Civilization

Over the last 800 thousand years ago, humans have removed around 50% of the forest area. These have been replaced with crops, pastures, settlements, and others. Several hundreds of years ago, the forest areas were 7.2 billion hectares, covering 48% of the land. At present, the area covered by the plants is 12.2 billion hectares, 4.1 billion of which are forests. Out of this, only 3.8 billion hectares are covered with woody plants, while the rest are bushes, marshes, and cliffs (Gulisashvili 1973). Seventy-five percent of forest destruction has taken place during the twentieth century following a global demographic explosion. Eighty percent of forests have been replaced with cultural trees.

According to FAO estimates (Table 13.1), forests were covering 4000 million ha of land or 31% of its total area. 1488 million ha represents sparse forests, bushes, and roadside trees that are not included in the forest category. In the world's forests, up to 30,000 species of trees and shrubs grow and thousands of animals and birds live there. In the early twentieth century, the forest area was about 2 ha per capita. In 2015, the per capita has come down to just 0.6 ha of forests. The total produce of live forest is 1509 billion tons, of which 25% (377 billion tons) comes from the roots, leaves, and fruits, and the remaining 1132 billion tons represent timber. The world's timber reserves in cubic meters are 360 billion m^3, and the annual increment (productivity) is 3200 million m^3 (Kandelaki 2013).

With regular inventory prepared by FAO, forestry has decreased at higher rates from 1990 to 2000. The annual decrease was 16 million hectares and in 2000–2010, 13 million hectares, and in 2010–2015, the forest area decreased by 16.5 mln ha or yearly forests got decreased by 3.3 mln ha. In 2016, the destroyed forest area was 29.7 million hectares (Kandelaki 2013).

The Forest destructions are increasing geometrically every year. The reason being tree cutting as well as turning forest areas into other land use categories (arable, towns, roads, etc.). Natural disasters like landslides and avalanches also destroy forests as these trees are not restored. According to the National Geographic, 80,000 m^2 of green cover is damaged annually, causing great material loss. Fires have resulted in 100,000 deaths in Indonesia. In 2017, about 100 people were killed in California, Portugal, and Spain because of forest fires. Fires were hugely

Table 13.1 Areas of the world's forests and their dynamics

Region	Common area (mln ha)	Forests of local species, (mln ha)	Forest (% from the total area)	Dynamics of forest areas (mln ha)		
				Change of forest area (2010–2015)		Forest plant area
				Total	Annual	2015
World	3999	1277	31	−17	−3.0	290
Africa	624	135	23	−14.2	−2.4	16
Asia	593	117	19	−3.4	0.8	129
Europe	1015	277	34	1.9	0.3	82
North and Central America	751	320	33	0.4	0	43
South America	842	400	49	−10.1	−2	15
Oceania	174	27	23	1.5	0.3	4

destructive in California in November 2018 when more than 70 people got killed, 1400 people were lost, up to 100 ha forest was burned, and about 80,000 houses were destroyed. It is important to note that during fires, besides people, a lot of other living organisms in the woods also die. In addition, fires cause much addition of excessive carbon in the atmosphere, which negatively affects water quality, forest structure, and biodiversity.

Following the earlier forest destructions, from the beginning of the twenty-first century, forest cover has increased by artificial forests (3.3 million hectares) or naturally restored forests (27 million ha a year). From 2000 to 2010, the forest area in Asia grew by 2.2 million ha, mainly due to the intensive cultivation of forests in China. Forest areas in Europe have grown annually by 700 thousand ha.

13.9 Forests in Georgia

13.9.1 Layout and Composition

Georgia is located in the southwest of Caucasus, with diverse climates and landscapes. It is wet-oceanic in the subtropics to the west, steppe-continental to the south and constant snow and glaciers in the highlands of north. Mountain slopes in Georgia were covered with dense forests, where many varieties of fruits were produced and many species of animals and birds lived there. The Georgian peasants were allowed to live there, and they were defended and fed by the forest. As such, the forest industry has been created there long back.

The forests in the country start from the seashore, extending to 2100–2200 m and in some cases up to 2500 m. The total forest cover lies around 3,007,600 hectares as per 2010 records, which is 43.2% of the country's territory. It is spread unequally, 58% in the west and 42% in the east. Seventy-three percent of the forests are located at a height of 1000 m above, 80% of these are spread over the slopes of over 20°.

Forests cover 2,770,000 ha of the state forest fund of Georgia, with 86 protected areas covering 600,000 ha (Anonymous 2012, 2018).

The forests in Georgia include coniferous, deciduous, evergreen, and leafless trees, shrubs, giant sized (up to 60 m and 2 m in diameter) trees, lianas, parasitic plants, mushrooms, fruits, berries, and medicinal and technical raw material plants. There are many relict and endemic species. Out of the 400 taxa, 61 are Georgian and 43 Caucasian endemics. In the forests, the coniferous palms are 16%, the hardwood deciduous 68%, softwood leaflets 7%, and other species 10%. The giant (70 m high and 2.5 m diameter) Caucasian Sochi beeches together with 50 m high and 2 m diameter east beech are considered as a phenomenon for the moderate climate zone. Chestnut, oak, maple, zelkova, walnut, box tree, and other types of tree timbers are economically important (Gigauri 2004).

In the valleys of high mountains and hard-to-reach gorges, the untouched forests (566,000 ha) are still seen. According to the World Bank experts, in Europe, we can hardly find a country where the natural landscapes of unique beauty are so exquisitely replaced by old cultural landscapes. It is noteworthy that the forests of Georgia are a shelter of pre-Ice Age flora and fauna, or relicts, all connecting us with ancient geological epochs, and their area will be a huge loss not only for Georgia but for the humanity as a whole.

13.9.2 Forest Resource Potential of Georgia

Forest resources are very important in terms of average forest characteristics like age 98 years, height 22 m, diameter 36 cm, Bonita III, and frequency 0.54. Timber supplies lie around 176 m^3 per hectare, ripe and overripe copse 244 m^3, and conifers 288 m^3. Total timber reserves in the forests are more than 535 million m^3. Almost 66% of reserves are in the unattainable zone, where the slope incline is greater than 25 °C (Anonymous 2012, 2018).

Along with timber, more than 150 species of plants in the forests bear fruits, berries, walnuts, and other resources, which are used much and make significant contributions to economic development. More than 110 species of plants are used in medicine. 2/3 of the 48 medicinal and 200 recreational resorts of Georgia are located or surrounded by forest. Their existence in the forest is justified by an aesthetic viewpoint. Therefore, ecotourism and resort-recreational farming are developed in Georgia. The potential of hunting tourism is also great in Georgian forests.

13.10 Results of Anthropogenic Impact on Forest

No one argues about the great importance of green forest cover, but for the proper attention to it, it is not yet visible. The reason for this is the enormous increase in demand for forest resources as a result of population growth and technical

advancements. Therefore, the extraction and use of forest resources in the world are increasing annually. Such attitude toward forests leads to their destruction, especially in the tropical and coniferous (taiga) areas. It is noteworthy that the use of forest areas has helped not only the plant but also the reduction of unique representatives of animals and birds.

Particularly negative consequences are expected from cutting of forests in mountainous areas where the river water regime changes, catastrophic floods and torrents increase, erosive and landslide phenomena develop, soil erosion occurs with stone erosion, and snow-glacier evolution all take place (Basilashvili 2016b; Altay 2019).

In addition, trees are usually cut into forest copse as well as in the towns and planting strips, which, in addition to the lack of oxygen, result in the reduction of water keeping and catchment function, causing drying of some springs, rivers, and lakes. The areas that aren't covered by the forest begin to become a desert, accompanied by the reduction of food production (Ozturk et al. 2010; Altay et al. 2012; Basilashvili 2015; Ozyıgıt et al. 2015; Sezer et al. 2015).

A reduced green cover in the world is no longer capable of the use and regulation of solar energy. This increases the amount of carbon dioxide in the atmosphere and the climate warms up intensively. Consequently, ecological disasters are activated, leading not only to destruction but also casualty of humans and other living beings.

The accumulated excess quantities of harmful gases allotted by the anthropogenic impact return to our Earth's atmosphere as acidic rains and radiation compounds. The sources of acidic rainfall (rain, snow, fog) come from fuel and biomass burning, metallurgy, motor transport, etc. During the past 100 years, the acidity of precipitation has significantly increased. Acid precipitations have a negative effect on ecosystems since such water drops on the spawns and phytoplankton, reducing the types of hydrophones in the reservoirs. Such precipitations also cause corrosion of tools, buildings, and art samples, and plants are damaged that is expressed by the falling of leaves and the rotting of roots. In 1990s, the area of damaged forests in Germany and Netherlands was 50%, Switzerland 35%, Austria 30%, and Russia 600,000 ha (Qajaia 2008). Thus, the cosmic ecological function of forests got weakened. It is estimated that the cosmic environmental effect performed by the forest green cover exceeds 3–5 times the natural revenue received by the use of forest resources (Chagelishvili and Gvazava 2015).

13.11 Conclusions and Recommendations

Forest are a complex ecosystem of trees, plants, and other living organisms (Ozturk et al. 2010; Altay et al. 2012; Karahan et al. 2015; Ozyıgıt et al. 2015; Sezer et al. 2015; Altay 2019; Rajpar et al. 2020). All these are a guarantee of preservation of cosmic-ecological-economic-sustainable environment of the biosphere on Earth, along with water, air, and soil. The forests absorb carbon dioxide and releases large amounts of oxygen, at the same time regulating microclimate (humidity, temperature, and wind). The forest is a powerful filter for cleaning air and water from harmful

impurities, characterized by antimicrobial, ionization, and sterilization features. By doing so, it makes the environment healthy and friendly, which in turn affects humans and other living organisms. The forests also provide many types of food and medicinal products. Thus, the forest is a powerful factor in improving environmental sanitation-hygienic conditions with a broad spectrum of biodiversity, hence named as vital "green lungs."

Moreover, the forests protect agriculture and populated areas from strong wind. They are also the main factor for regulating water resources, improving groundwater quality, and increasing their storage. In the mountains, forests protect communities, roads, and fields from floods and mudflows, erosion, landslides, and avalanches, promoting an increase in the yield.

A forest has great importance in agricultural activities. It is a source of raw timber used in various industries. With an increase in population and farming activities, the demand on timber has increased much. As such, forests are cut and forest area is getting reduced by 0.3% annually in the world. Over the last decade, 25,000 plants and more than a thousand species of animals are completely lost. The reason is wrong approach toward the forests. In fact, nature is a gift that we must use to benefit from. Due to pollution, the forests are dying.

In addition to tree cutting and diseases, forests are also damaged by fires, which have become more frequent in different countries due to the negligence of the people in terms of climate warming. It is noteworthy that fire prevention is much cheaper than elimination of its results, which is not fulfilled. Because of this, the world's lost green cover is no longer able to regulate the heat energy of solar radiation. Oxygen is decreasing and carbon dioxide is increasing in the atmosphere, and climate is warming up intensively.

According to the conclusions from experts, global warming in the twenty-first century will continue, and the temperature of Earth may increase by 2–4 °C, which will seriously damage the ecosystems and most of the countries' economies. The technical progress on the one hand is improving the conditions of human well-being, but on the other hand, it threatens our future. The process of weakening of self-purification, self-regulation, and self-restoration is underway not only in a specific environment but also on a planetary scale.

Today, the protection of nature and the rational use of its resources is our primary problem. It is a necessary precondition for the existence of the biosphere. Therefore, in all countries of the world, special attention should be paid toward the protection and expansion of forest cover. The people and administration in every settlement should take care of his forest cover and work for its renovation. Useful plant varieties should be selected for renovation, and, if necessary, their selective cuts should be carried out in a number of annual increments so as to ensure that their natural recovery is restored. In agricultural fields, the protective lines of the forests should be planted, which will help to increase yield. In order to ensure rational use of forest resources, measures must be undertaken with complex non-waste technologies.

In order to protect the biodiversity of forests, the system of biomonitoring should be followed and timely restoration of forests and their management carried out. It is necessary to develop long-term programs for the rational use of forest resources in

order to improve forest productivity and their qualitative composition. Complex production of timber raw materials, introduction of techniques of progressive methods of processing and non-waste technologies, and finally creating protected areas for the purpose of maintaining biological and landscape diversity are very important steps in this connection.

It is also necessary to raise the knowledge of the society on the whole to increase their positive role towards nature and its rational use. Proper education of youth and their love for nature can save the biosphere and our natural environment from destruction and bring us economic prosperity.

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