Chapter 11
Bulgaria

Nickola Stoyanov and Maria Stoyanova

11.1 The Bulgarian National Forest Inventory

11.1.1 History and Objectives

11.1.1.1 Forest Management Planning

Bulgaria has more than 110 years history of forest monitoring and forest management planning. The first State Service on Measuring and Organisation of Bulgarian Forests was created in 1901, when the first of three Forest Management Plans (FMP) were established. During the period from 1901 to 1919, 225,000 ha were inventoried and described during the FMP process (Raykov 2006).

Regardless of the strict requirements of forest laws, prior to 1944 only 28 % of forest areas were monitored using FMP's. The share of the whole forest area monitored in FMP for the different kinds of ownership is the following: 50 % for state forests, 22 % for the municipality forests and 8 % for the private forests. After the end of the Second World War, the forest sector and the Forest Management Organisation in Bulgaria developed quickly in order to satisfy the requirements of the time. During this period the State Service for the organisation of forests were transformed into an institute for research and development in agriculture and forestry (Agrolesproekt). From 1950 to 1954, 2,890,000 ha were inventoried and described in FMP's. During this period FMP's were completed for all forest areas. Forest management plans and programs specify the allowable amount of forest resources to be felled and issue guidelines to achieve the objectives of forest

N. Stoyanov (✉)
University of Forestry, Sofia, Bulgaria
e-mail: stoyanovnick@abv.bg

M. Stoyanova
Forest Research Institute (BAS), Sofia, Bulgaria
e-mail: mst@mail.orbitel.bg

management for the area for the following 10 years. All forest management works undertaken are in accordance with the approved FMP's (Raykov 2006).

In the period 1955–1980 the original basis of the FMP process was improved by incorporating scientific methods. FMP were elaborated on the basis of forest types. During more recent years, Agrolesproekt invested considerably in new techniques and technologies. GPS was introduced into the FMP process. Now the country has completed GIS maps of the forest estate and attribute data can be captured in real time. Combined with the use of precise satellite images and remote analysis, the FMP data provides a comprehensive forest inventory and FMP for the next decade. The GIS system also increased the precision and effectiveness of the field work. FMP data are a valuable basis for the analysis, monitoring, assessment of global tendencies in our forests, as well as for planning, etc.

After 1997, with the restoration of forest property to former owners, private companies began to implement FMP in competitive conditions. According to Bulgarian forest Law (The Forest Act 2011) it is necessary to establish the state of resources by undertaking an inventory of the forest areas. Data from FMPs are public and the access to them is determined by the Forest Act (2011).

Forest plans are prepared for forest areas that are owned by the state, municipal property, private individuals and companies. Areas used for the purposes of national security and defence are excluded. There are two types of forest plans depending on the size of the holding:

1. Forest Management Plan
   Forest management plans for state owned forests regardless of forest area. Forests owned by individuals, legal persons and their associations with a total area up to 2 ha.
2. Forest Program
   Forest areas, the property of individuals, legal persons and their associations with a total land area of their estate from 2 to 50 ha are made forest programs. State forests do not have to prepare forest programs.

11.1.1.2 National Forest Inventory

Since 2011, it is mandatory to carry out a National Forest Inventory (NFI) due to the implementation of forest legislation (Forest Act 2011) for the purposes of developing state forest policy and the forestry sector.

The decision to implement the NFI will be decided by the Council of Ministers following recommendation by the Minister of Agriculture and Food. The management of the NFI shall be entrusted to the Executive Forest Agency (EFA) and funded from the state budget. Until now, due to the lack of financial resources, Bulgaria has not started a NFI.

The Minister of Agriculture and Food specifies conditions and procedures to prepare and to update the inventory of forest areas, regional plans for development of forest territories, hunting management plans, as well as forestry plans and programs.

During the FMP forests are described using quantitative and qualitative parameters. The accuracy of the estimates is between 5 and 10 %. Permanent sample plots will be used to monitor the forests according to a methodology approved by the EFA. The boundaries of separate parts of the forests, assessed by the FMP, will be used for stratification purposes to implement a statistical NFI.

The NFI will be undertaken to (i) facilitate the management of forest resources, (ii) identify sectors for investment, (iii) monitor and control ongoing biological-ecological processes, (iv) monitor sustainability of harvesting (v) inform forest policy and strategy at country and regional level.

The classification and evaluation indicators of the NFI should be consistent with the previous measurements and Forest Management Plans, as well as with other European NFI's. General statistical information concerning forests from the NFI should also be consistent with current forestry statistics in the Republic of Bulgaria.

As the NFI is currently not in place, the subsequent sections will focus on the FMP.

11.1.2 Sampling Methods and Periodicity

After 1955, when all forests were inventoried using Forest Management Plans, about 15–20 State Forest Enterprises (SFE) and State Hunting/Game Enterprises (SH/GE) were assessed each year. The state forest area is divided into compartments and sub-compartments. The boundaries of the compartments are natural terrain features, such as ridges, valleys, rivers, lakes, or man-made features. In the absence of sufficient natural and man-made features, boundaries are formed within the forest by felling trees and painting the border trees. The area of compartments ranges from 40 to 80 ha for clear cutting method of harvesting and from 5 to 25 ha for the selective harvestings. Stratification is based on forest maps produced in the previous inventory cycle. Sub-compartments are the smallest territorial units of forests and remain relatively constant as they are the basis for forests inventory and management. The main variables that define a sub-compartment are species and management system.

During the inventory, forests are described using quantitative and qualitative parameters which outline the set of activities and operations within the compartments and sub-compartments. The range of parameters and evaluation indicators is mandatory for all forests, as determined according to the needs of forest management practices and the requirements of international agreements and documents, to which Bulgaria is a party.

11.1.3   Data Collection

This section describes the attributes assessed:

General Information—number of compartment, the number of sub-compartments, rotation age, felling, type of forest

1. Quantitative tree attributes—composition in tree species, tree species crown cover area, tree species age, stand density index, average diameter, average height, productivity class, stock, use (removals)
2. Text description of the forest cover—origin, form, structure, condition, type of mixture, trees above the forest, Landscape Assessment
3. Habitat description—exposure, slope, altitude, relief, bedrock, soil nature, habitat, optimal future species composition, litter, coverage of grass, shrubs, technical valuable medicinal plants
4. Reforestation—composition, age, height and percentage of cover
5. Health Record
6. Biodiversity
7. Accessibility—transportation distance in meters to forest road; road category, distance to the closest settlement and category of the cutting area, and some other particulars referred to in methodology for economic evaluation of forest lands. Distances are measured from the base forest map
8. Planned activities—Cutting, Thinning, Schedule for reforestation, land preparation
9. Other information.

11.1.4   Data Processing, Reporting and Use of Results

The data processing consists of the following steps:

1. Estimation of tree volume for sample tree
2. Estimation of stand volume
3. Establishment of the quantity of timber assortment by categories
4. Establishment of the current increment.

Sample tree volume is estimated with general volume functions using diameter at breast height (dbh), form factor (F), and height (h) as regressors. Volume is expressed in cubic meters (m^3).

Data and results from the Forest Management Plans and Programmes are used for national and regional forest statistics, for international reporting (Global FRA, FOREST EUROPE, Natura 2000 Network directive reporting, etc.). Also, the data are used for the management of forest units, planning forest and harvesting activities, research and for the estimation of future production potential of timber and forest bioenergy.

11.2 Land Use and Forest Resources

11.2.1 Classification of Land and Forests

11.2.1.1 General Land Classification

In the national land use classification system, the total land of country is divided into six categories: Agriculture land, Forest land, Settlements and other urbanized lands, Water bodies, Mining and quarrying areas and Transport and infrastructure (National Statistic Institute 2012) (Table 11.1).

11.2.1.2 Forest Classification by Use

For the purposes of national Forest Law, forests are defined as:

1. Land occupied by forest tree vegetation in an area of not less than 0.1 ha, tree height of the stand at maturity is not less than 5 m, a width of the stand, as measured between the stems of the trees in the forest edge, is not <10 m, and projection of the crowns at least 10 % of the area of the forest
2. Areas which are in the process of renewal and have not yet reached but are expected to reach a minimum projection of 10 % canopy and tree height of 5 m
3. Areas as a result of human activity or natural causes that are temporarily tree-less, but are subject to renewal
4. Protective forest belts and strips of trees with an area greater than 0.1 ha, and a width over 10 m
5. Plantations used for the protection against the harmful effects to water
6. Mountain pine (*Pinus mugo*) formations
7. Communities of trees or shrubs located near water bodies.

Table 11.1 Land use/land cover class areas according to the national and FRA (2010) definitions

Type of territory (according to Bulgarian legislation)	Area (1000 ha)	Type of territory (according to FRA (2010))
Total area	11,100	Total area
Agricultural	6376	Other land (OL)
Forest	3716	Forest, OWL
Settlements and other urbanized territories	460	OL, partly OLwT (other lands with trees)
Water bodies	201	OL
Mining and quarrying	271	OL
Transport and infrastructure territories	76	OL

Forest areas for the purposes of the Law are:

1. Forests defined above in the previous paragraph
2. Bare, unproductive forest lands and other areas for forestry activity
3. Karsts formations, located in the lands of items 1 and 2 above
4. Protecting forest belts with dimensions smaller than 0.1 ha and a width of 10 m.

The provisions of the Law for forests shall not be applied to:

1. Parks and gardens in urban areas (Protected Areas Act 1998)
2. Forests and lands in national parks and reserves (Protected Areas Act 1998)
3. Forest tree species in agricultural areas
4. Areas covered with forest vegetation within the scope of national and local roads and railways.

According to FRA (2010) forest territories are divided into the following categories: forest, other wooded land (OWL), other lands (OL) and other lands with tree cover (OLwTC). According to Bulgarian forestry legislation all afforested lands are considered forest territories i.e. afforested area, plus the area of Mountain pine formation. Non-forested areas subject to afforestation are forest territories as well, but if at the time of assessment they are area without forest cover, then they are classified as OL (Table 11.2).

Table 11.2 Distribution of forest area (1000 ha) by ownership, according to national definitions

Ownership	Types of area (1000 ha)				Total area (1000 ha)
	Forest area	Area of Mountain pine (*Pinus mugo*)	Non-forest areas for afforestation	Non wood productive area	
1. State	2730.5	21.6	53.3	261.4	3066.8
–State forests	2611.6	0.2	52	221.8	2885.6
–MoEW's* forests	108.3	21.4	1.3	38.9	169.9
–Educational and experimental forests	10.6	–	0	0.7	11.3
2. Community	465.4	0	10.2	28.1	503.7
3. Private legal persons	405.2	0.4	5.5	10.8	421.9
4. Private juridical entities	27.5	–	0.5	1.9	29.9
5. Forests of religious organisations	18.1	1.7	0.4	3	23.2
6. Forests in agricultural land	90.9	–	0.8	0.9	92.6
Total	3737.5	23.8	70.8	306	4138.1
FRA area class	Forests	OWL	OL	OL	

*MoEW—Ministry of Environment and Waters

11.2.1.3 Classification by Ownership Categories

In Table 11.2 Bulgarian forest land information is presented also for the different forest ownership categories. Public ownership (state and community) is the dominant class in Bulgaria's forests, occupying 74 % of the total forest area.

11.2.1.4 Forest Management and Cutting Systems

The main purpose of forest felling is to enhance natural regeneration, to improve forest growing conditions and to achieve the objectives set out in the forest plans and programs. In the case of damage caused by biotic and/or abiotic effects, felling is implemented to improve the health of crops as well as to reduce and prevent the risk of further loss. Logging is conducted on the basis of a written permit issued by the director of State Forest Enterprise or licensed foresters. When conducting felling the following general principles are applied:

1. Creating tree species diversity, while maintaining a single occurring specimens of valuable tree species
2. Conservation of the habitats of forest animals and birds
3. Maintenance of forest fruit trees
4. Preserve trees on the edge of the forest, regardless of the stem and crown quality, if they are in good health
5. Conservation of the diversity in forest stands by maintaining rare forms and those characterised by high productivity, good stem form and valuable technical properties of the wood
6. Protection of biotope wood, including standing and lying dead wood, hollow trees and nests.

Thinnings are conducted during the period from the emergence of the plants until maturity and are carried out to achieve the following main objectives:

1. Regulating the composition and origin of stands depending on their functions and goals
2. Improve growth and increase the productivity of crops and the quality of the wood
3. Selection of trees in stands
4. Improving security and the special functions of forests
5. Improve the health and sustainability of stands
6. Maintenance and protection of forest biodiversity
7. Reduce the risk of the occurrence of forest fires
8. Shortening the period for the production of quality wood.

The intensity and repetition of thinning depends on the stand density index, the openness of the stand canopy, species composition, age and stand condition. The thinning types are: lighting, tending, thinning, severance thinning, selective thinning and thinning for individual production of quality wood.

Regeneration fellings carried out in mature stands aim to:

1. Provide an opening to create a new generation of forest
2. Guide the process of regeneration
3. Regulate species composition and the direction of change in species composition
4. Protect and restoring biodiversity and gene pool
5. Produce and extract wood quality
6. Create and maintain uneven-aged forests.

The type of restoration felling, the intervals at which it takes place and the duration of the renewal period shall be determined by the management objective, silvicultural system being implemented, plant health, site conditions, composition, quantity, quality and spatial arrangement of undergrowth. Regeneration fellings include three main categories:

1. Gradual—Gradual felling is a regeneration felling with advance and simultaneous seed regeneration in which the mature standing forest is cut in two or more times during the renewal period
2. Selective—Selective cutting are held in high stem forests by periodically over the entire area of the plantation removing single or groups of trees of a certain size, without going to final felling. Selective felling combine simultaneous cultivation and regeneration of the plantation and applied to achieve and maintain uniformity of spatial and age structure of the plantation and to improve their quantitative and qualitative indicators
3. Clearcut—Clearcuts are felling, followed by regeneration. They occur in poplar, linden and willow forests, as well as stands managed for coppicing.

11.2.1.5 Legal and Other Restrictions

Forest areas according to their predominant functions are divided into three categories (The Forests Act 2011) (Table 11.3):

1. Protected forests for the protection of soil, water, urban areas, buildings and other infrastructures; tree lines and forest belts for protection as well as forests created for erosion control

2. Special forests:

- Within the boundaries of protected areas declared under the Biodiversity Act (2002) as well as those under which other protection laws are defined
- For seed crops and gardens, nursery, experienced and geographical cultures of forest tree and shrub species, arboretums, research, training and experimental forests, nests, up to 200 m around the tourist lodges and sites of religious significance; bases for intensive management of wildlife
- With recreational importance, of maintaining the landscape and with high conservation value

3. Commercial forests that are not covered in above mentioned categories and whose management aim is the sustainable production of timber and non-timber forest products, as well as the provision of services.

Forests in Bulgaria have to be managed in accordance with the Bulgarian Forest Act, 2011 and several other Acts. They ensure the sustainable management of forests and specify limits for the area of clear-cuts, restrict the harvest in pre-mature stands by limiting the intensity of tending activities, and define species-specific age-limit to prevent pre-mature clear-cutting of stands. They also contain specifications for forests with protective functions, forests with special natural habitats like national parks, natural forest reserves, and nature protection areas, and for forests in recreational areas. The availability of wood resources is also restricted in plans for the management of protected territories, water protection areas, military training areas, research forests, etc.

An important point with regard to the availability of wood resources is the accessibility, particularly in mountainous regions. Long logging distances and steep slopes increase the haulage costs. Cable crane logging is necessary in forest areas that cannot be accessed due to steep slopes. These logging technologies are more expensive than conventional methods and may not be economically feasible in every case. Some sites have poor productivity and render forest management operations irrelevant. Ecological considerations to sustain the site productivity can also restrict the amount of wood removed in harvesting operations.

11.2.1.6 Further Classification of Forests

The classification of the Bulgarian forest area by dominant species is presented in Table 11.4. The dominant species are Oak species (*Quercus robur*, *Quercus petraea*, *Quercus pubescens*, etc.), Scots pine (*Pinus sylvestris*), beech (*Fagus sylvatica*) and turkey oak (*Quercus cerris*).

Tables 11.5 and 11.6 describe the tree species distribution within the forest estate. Scots pine (*Pinus sylvestris*) and beech (*Fagus sylvatica*) are the two most important forest tree species, with oak species (*Quercus robur*, *Quercus petraea*, *Quercus pubescens*, etc.) being the most important coppice species in the low stem

Table 11.3 Total forest area (1000 ha) and volume (1000 m^3) by predominant function categories and by tree species groups

Categories	Total (coniferous + broadleaved)			Coniferous			Broadleaved		
	Total area	Afforested area	Volume	Total area	Afforested area	Volume	Total area	Afforested area	Volume
Protected	519	439	79,437	164	144	35,873	355	295	43,564
Special	1065	935	192,687	380	317	85,323	685	618	107,384
Commercial	2554	2387	372,230	735	684	166,044	1819	1703	206,186
Total forest	4138	3760	644,353	1279	1145	287,239	2859	2615	357,114
Incl. Natura 2000	1224	1111	215,081	363	334	91,590	861	777	123,491

Table 11.4 Forest area classified by dominant species according to national definitions

Tree species	Area (1000 ha)
I. Coniferous	**1071.3**
–Scots pine (*Pinus sylvestris*)	555.1
–Black pine (*Pinus nigra*)	287.5
–Spruce (*Picea abies*)	160.4
–Fir (*Abies alba*)	32.4
–Others (total)	35.9
II. Deciduous high stem	**909.3**
–Beech (*Fagus sylvatica*)	443.0
–Oak (*Quercus* sp.)	199.7
–Turkey oak (*Querqus cerris*)	68.5
–Hornbeams (*Carpinus betulus*)	52.1
–Lime (*Tilia* sp.)	46.8
–Poplar (*Populus* sp.)	23.5
–Others (total)	760
III. Coppice forests and low stem forests—total	**1756.9**
–Oak (*Quercus* sp.)	718.7
–Turkey oak (*Querqus cerris*)	339.0
–Beech (*Fagus sylvatica*)	172.3
–Black locust (*Robinia pseudoacacia*)	150.6
–Oriental hornbeam (*Carpinus orientalis*)	142.3
–Hornbeam—(*Carpinus betulus*)	104.8
–Lime (*Tilia* sp.)	9.4
–Others (total)	119.9
Deciduous high stem—total	909.4
High stem—total	1980.7
Total forest area	3737.6

forests. Distribution by age classes is more regular in the broadleaf forests, while in the coniferous forests 47 % are in the 21–40 age class.

11.2.2 *Wood Resources and Their Use*

11.2.2.1 Standing Stock, Increment and Drain

The total stock of Bulgarian forests is about 645 million m^3 with an annual increment of 14.458 million m^3. The share of coniferous in total growing stock is 44.5 % and in the annual increment 48.2 %. The calculation of volume of coniferous are made without bark and of deciduous species with bark. The main indicators for Bulgarian forests at the beginning of the 21 century are showed in Table 11.7.

Table 11.5 Distribution of forest area (2010) of high stem forests (1000 ha) depending on their functions (according to classification of Law for forests—2011)

Tree species	Total area (1000 ha)	Age classes—years								Average age
		10–20	21–40	41–60	61–80	81–100	101–120	121–140	Over 140	
I. Coniferous	**1071.3**	**119.3**	**450.3**	**187.8**	**89.1**	**115.1**	**73.7**	**25.3**	**10.7**	**50**
Scots pine (*Pinus sylvestris*)	555.1	62.5	248.9	92.9	53.6	60.7	30.0	5.5	1.0	47
Black pine (*Pinus nigra*)	160.4	12.6	36.2	13.8	17.2	35.8	28.8	12.2	3.8	73
Spruce (*Picea abies*)	287.5	39.0	146.9	73.5	12.4	7.9	4.9	1.9	1.1	38
Fir (*Abies alba*)	32.4	0.9	4.6	3.1	3.3	6.8	7.0	4.3	2.4	87
Macedonian pine (*Pinus peuce*)	13.9	0.8	1.1	1.1	2.0	3.4	2.6	0.9	2.1	90
Bosnian pine (*Pinus leucodermis*)	1.3	0.0	0.1	0.1	0.2	0.3	0.1	0.1	0.4	104
Douglas fir (*Pseudotsuga menziesii*)	7.4	0.9	5.5	0.9	0.0	0.0	0.0	0.0	0.0	30
Larix spp.	0.6	0.1	0.4	0.1	0.0	0.0	0.0	0.0	0.0	32
Others (total)	12.7	2.5	6.6	2.3	0.3	0.4	0.3	0.3	0.0	37
II. Broadleaved high stem	**901.8**	**115.9**	**167.1**	**127.7**	**78.8**	**113.5**	**119.4**	**93.2**	**86.4**	**74**
Beech (*Fagus sylvatica*)	440.9	24.3	53.5	41.4	40.7	75.1	79.7	62.9	63.4	91
−Oak (*Quercus* sp.)	198.2	28.0	43.2	23.7	15.7	25.6	26.7	19.8	15.5	71
−Turkey oak (*Quercus cerris*)	68.5	17.3	13.2	11.8	5.7	5.0	5.9	5.4	4.2	58
−Hornbeams (*Carpinus betulus*)	51.3	6.4	14.5	11.7	5.1	4.1	4.6	3.0	1.9	58
Elm (*Ulmus* sp.)	2.0	0.3	0.7	0.6	0.1	0.1	0.1	0.2	0.1	52
Fraxinus spp.	15.0	2.2	4.7	4.9	1.3	1.0	0.4	0.3	0.1	47
Lime (*Tilia* sp.)	46.8	7.6	12.7	18.7	6.2	0.8	0.5	0.2	0.1	43
Poplar (*Populus* sp.)	23.5	19.5	3.1	0.8	0.1	0.0	0.0	0.0	0.0	14
Aspen (*Populus tremula*)	6.4	1.0	1.6	1.7	12.9	0.6	0.2	0.0	0.0	63
Maple (*Acer* sp.)	4.3	1.6	1.3	0.5	0.1	0.1	0.2	0.2	0.3	43
Birch (*Betula alba*)	9.1	1.6	5.0	1.6	0.5	0.2	0.0	0.0	0.0	35

Table 11.5 (continued)

Tree species	Total area (1000 ha)	Age classes—years								Average age
		10–20	21–40	41–60	61–80	81–100	101–120	121–140	Over 140	
Chestnut (*Castanea sativa*)	2.6	0.4	0.8	0.7	0.1	0.1	0.0	0.1	0.4	59
Walnut (*Juglans regia*)	7.2	0.7	5.2	1.2	0.0	0.0	0.0	0.0	0.0	32
Others (total)	26.2	5.0	7.6	8.2	1.9	0.8	1.1	1.1	0.3	46
III. For reconstruction	**7.5**	**0.2**	**0.9**	**1.8**	**1.2**	**1.7**	**0.6**	**0.7**	**0.5**	**77**
Beech (*Fagus sylvatica*)	2.1	0.0	0.0	0.1	0.3	0.7	0.2	0.4	0.3	102
Oak (*Quercus* sp.)	1.5	0.0	0.2	0.4	0.3	0.3	0.1	0.1	0.1	70
Turkey oak (*Quercus cerris*)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58
Hornbeam (*Carpinus betulus*)	0.8	0.0	0.1	0.1	0.1	0.2	0.1	0.2	0.0	89
Oriental hornbeam (*Carpinus orientalis*)	1.9	0.1	0.5	0.8	0.3	0.2	0.1	0.0	0.0	54
Others (total)	1.3	0.1	0.1	0.3	0.2	0.3	0.1	0.1	0.0	73
Broadleaved high stem—total	909.4	116.1	167.9	129.5	80.0	115.2	120.0	93.9	86.8	74
High stem—total	1980.7	235.3	618.3	317.3	169.1	230.3	193.7	119.2	97.5	61

Table 11.6 Distribution of forest area (1000 ha) of low stem forests depending on their functions according to national definitions (2010)

Tree species	Total Area (1000 ha)	Age classes—years													Average age
		1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	Over 61	
Coppice for conversion	**1320.9**	**21.2**	**25.4**	**34.5**	**41.1**	**36.0**	**39.5**	**35.9**	**73.2**	**97.5**	**195.0**	**168.9**	**211.4**	**341.3**	**48**
Oak (*Quercus* sp.)	649.2	10.6	13.1	16.4	18.7	15.5	18.0	16.9	37.9	53.0	101.1	82.3	103.0	162.8	48
Turkey oak (*Quercus cerris*)	312.2	6.1	5.5	8.0	10.4	9.2	8.9	8.1	16.6	25.4	50.5	49.7	52.1	61.8	47
Beech (*Fagus sylvatica*)	169.9	0.8	1.1	1.8	2.9	3.3	4.2	3.8	6.8	6.3	19.6	14.1	29.2	76.2	53
Hornbeam (*Carpinus betulus*)	96.9	1.3	1.8	3.2	3.6	3.3	3.5	2.9	5.6	7.0	12.4	12.8	15.5	23.9	47
Lime (*Tilia* sp.)	7.7	0.2	0.2	0.2	0.4	0.4	0.4	0.3	0.5	0.7	1.1	1.1	1.0	1.3	44
Others (total)	85.0	2.2	3.7	4.9	5.2	4.3	4.6	4.0	5.8	5.0	10.3	9.0	10.6	15.3	41
Low stem—total	**436.0**	**46.0**	**47.4**	**49.7**	**43.5**	**29.9**	**29.8**	**19.2**	**27.3**	**22.2**	**33.6**	**22.9**	**27.9**	**36.6**	**29**
Oak (*Quercus* sp.)	69.5	4.3	3.7	5.1	6.4	5.4	6.8	3.9	5.9	3.9	7.8	3.1	6.2	6.9	34
Turkey oak (*Quercus cerris*)	26.8	2.3	1.9	2.2	3.0	2.9	2.7	2.3	1.6	1.2	1.9	1.2	1.4	2.3	30
Beech (*Fagus silvatica*)	2.4	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.4	0.7	42
Black locust (*Robinia pseudoacacia*)	150.6	31.8	30.9	27.6	19.4	11.3	8.7	5.6	5.1	3.7	3.0	2.4	0.6	0.4	16
Hornbeam (*Carpinus betulus*)	7.9	0.6	0.5	0.7	0.8	0.5	0.5	0.3	0.5	0.4	0.8	0.4	0.8	1.2	35
Oriental hornbeam (*Carpinus orientalis*)	142.3	4.3	6.7	10.1	10.8	7.5	8.5	5.5	11.4	10.2	16.9	12.8	16.3	21.5	39
Lime (*Tilia* sp.)	1.7	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.3	0.2	0.1	0.2	0.2	35
Others (total)	34.9	2.5	3.4	3.7	2.9	2.1	2.5	1.6	2.5	2.5	2.8	2.7	2.2	3.5	32
Total	1756.9	67.1	72.8	84.2	84.7	65.9	69.3	55.1	100.5	119.6	228.6	191.8	239.4	378.0	

Table 11.7 Bulgarian forests in the beginning of 21st century

Indicators	Units	Coniferous	Broadleaved high forest	For reconstruction	For conversion	Low-stemmed	Total
1. Forest area	1000 ha	1071	902	8	1321	436	3738
	%	28.6	24.1	0.2	35.4	11.7	100
2. Total growing stock	1000 m^3	287,118	186,234	382	153,032	18,164	644,930
	%	44.5	28.9	0.1	23.7	2.8	100
3. Increment	1000 m^3	6973	3163	7.1	3303	1012	14,458
	%	48.2	21.9	0.1	22.8	7.0	100
4. Increment per ha	m^3	6.51	3.51	0.94	2.50	2.30	3.87
5. Average age	Years	50	74	77	50	30	54
6. Average site class[a]		2.94	2.91	–	3.53	4.11	3.22
7. Annual harvest[b]	1000 m^3	3044	2325	12	2007	788	8176
8. Annual harvest per ha	m^3	2.84	2.58	1.50	1.52	1.81	2.19
9. Fellings	1000 m^3	2515	1558	–	2191	462	6.726
10. Share of fellings from the annual harvest plan	%	82.6	67.9	–	109.2	58.6	82.3

[a]The scale is between 1 and 5, with 1 the best and 5 the worst
[b]Annual harvest plan according to the Management plan

11.2.2.2 Tree Species and Their Commercial Use

The data in Table 11.8 show that the total removals are less than the annual increment and more than 50 % of the removals is used for firewood. More than 60 % from removals are from broadleaved and the share of high-stem beech is about 18 %. The highest share of firewood is in coppice species.

Table 11.8 Fellings and removals in the period 2006–2010 (1000 m^3)

	2006	2007	2008	2009	2010	Total 2006–2010	Average 2006–2010
Total							
Fellings	7234	6785	7317	5465	6726	33,527	6705
Removals	5992	5696	6071	4599	5669	28,027	5605
Industrial timber	2582	2571	2710	1662	2363	11,888	2377
Firewood and loppings	3410	3125	3361	2937	3306	16,139	3227
Coniferous							
Fellings	2785	2675	2953	1679	2515	12,607	2521
Removals	2125	2067	2281	1300	1961	9734	1946
Industrial timber	1646	1599	1733	894	1454	7326	1465
Firewood and loppings	479	468	548	406	507	2408	481
Broadleaved							
Fellings	4449	4110	4364	3786	4211	20,920	4184
Removals	3867	3629	3790	3299	3708	18,293	3659
Industrial timber	936	972	977	768	909	4562	912
Firewood and loppings	2931	2657	2813	2531	2799	13,731	2746
High-stem beech							
Fellings	807	758	856	687	771	3879	775
Removals	714	670	745	598	675	3402	680
Industrial timber	222	211	221	135	166	955	191
Firewood and loppings	492	459	524	463	509	2447	489
High-stem oak							
Fellings	252	256	216	180	205	1109	221
Removals	215	215	181	152	174	937	187
Industrial timber	51	63	52	36	47	249	49
Firewood and loppings	164	152	129	116	127	688	137
Other broadleaved high-stemmed							
Fellings	770	683	580	478	582	3093	618
Removals	668	604	510	423	511	2716	543
Industrial timber	271	257	243	205	244	1220	244
Firewood and loppings	397	347	267	218	267	1496	299
Coppice							
Fellings	2710	2140	2354	2126	2348	11,678	2335
Removals	2270	2140	2354	2126	2348	11,238	2247
Industrial timber	392	441	461	392	452	2138	427
Firewood and loppings	1878	1699	1893	1734	1896	9100	1820

11.3   Assessment of Wood Resources

11.3.1   Forest Available for Wood Supply

11.3.1.1   Assessment of Restrictions

The following factors mainly affect the availability of forests for wood supply.

A. Protected areas

   Forests within the ecological network are determined in accordance with Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna, called Habitats Directive. According to this law protected areas are declared in the country as part of the national ecological network. These are places of the territory that meet the requirements for the presence of biological diversity, for certain plant and animal species.

B. Recreation areas

   Areas reserved for recreation include areas established by owner's decision (state forests) or land use planning at municipal or county level. These areas are managed mainly for recreation values and forestry operations must be planned accordingly. In most cases, forestry is not profitable in these areas. The aim of forest operations, in these areas is to maintain and enhance recreation values. Normally, in these forests the rotation age is increase by one age class (20 years for high stemmed forests).

C. Protected biotopes, key habitats

   The forest act defines a number of biotopes that may not be managed or can only be managed carefully so that the natural elements are not endangered. Here the rotation length is increased and the availability of wood for supply decreases.

D. Protective functions

   In some forest areas forest operations are limited because these forests are devoted to the protection of soil, water, urban areas, buildings and objects of the infrastructure; tree lines, forest belts for protection as well as forests, created by technical projects for erosion control. Protection of forests in high altitudes causes limitations to forestry operations in mountains.

E. Special forest areas

   These areas are (i) within the boundaries of protected areas under the Protected Areas and Protected Areas declared under the Biological Diversity Act (ii) those on which under other laws are defined and introduced special status and modes (seed crops and gardens, nursery, experienced and geographical cultures of forest tree and shrub species, arboretums, research, training and experimental forests, nests, up to 200 m around the tourist lodges and sites of religious significance) (iii) basis for intensive management of wildlife (iv) with recreational importance, of maintaining the landscape and with high conservation value. The forest operations in these forests are carried out very carefully and according to special requirements.

 F. Other restricted areas (e.g. military)
     The military forest areas in Bulgaria are insignificant and the restrictions in
     them do not have important meaning.

In Bulgaria the availability of forest land for wood supply in the inaccessible areas has an important influence. These are forest areas to which no roads are available and in which it is not possible to carry out harvesting. During the forest inventory the volume of wood in inaccessible areas is calculated and included in the total volume, but in practice it is not possible to harvest this timber.

It is important to highlight that about two thirds of forests are owned by state and managed by foresters. The expectations of managers are to receive income mainly from felling. Private and municipality owners also expect to maximise the income from their forests.

11.3.1.2   Estimation

In all above mentioned forest areas with restrictions the measurement and establishment of forest volume is the same as in other forest areas. Calculating volume for felling is in accordance to the requirement of Forest law and other specific laws which are connected with the restrictions.

11.3.2   *Wood Quality*

11.3.2.1   Stem Quality and Assortments

Using volume and assortment tables, data on the volume and assortment structure of the standing tree stem is generated. For this purpose it is necessary to obtain dbh data in 4 cm diameter classes and the height in metres (m). When determining the assortment structure it is necessary to make a qualitative assessment of the stem. These operations are usually performed in conjunction with forest development inventory or at the stage of marking trees for cutting. The goal is not only to determine the volume stock of a stand for logging, but also to determine the assortment structure and an assessment of tree quality. Trees are divided into three groups:

1. Industrial wood
   Wood are considered perfectly healthy trees which, due to mechanical damage or bends, means that no more than 25 % has non industrial part.
2. Semi industrial wood
   Wood is related those trees which industrial wood is between 25 and 75 % of the total.
3. Fuel wood
   Wood unfit for industrial wood, i.e. >75 % fuelwood.

Before, a stem assortment structure is estimated into the industrial wood and fuel wood groups, the previously graded semi industrial wood is distributed equally into the two previous groups. Further practical assortment is done only for industrial stems according to the relevant tree species assortment tables, based on dbh and height grades.

11.3.2.2 Assessment and Measurement

As trees of certain standing timber are assessed independently from each other it is not necessary to measure the height of each. The method of establishing the height grade is recorded and can be estimated from a sample of heights on 10 trees with diameter approximately equal to the average diameter of the stand.

Trees, whose heights will be measured, are chosen uniformly from the entire stand. They should not be damaged, forked or with broken tops. The heights are measured by a hypsometer with an accuracy of 1 m. For each tree assessed for height the corresponding dbh with an accuracy of 1 cm is recorded. The mean height and the average diameter are calculated for the stand, which in turn is used to determine the species specific height grade for the callipered stand. In mixed stands of two or more tree species the height grade is calculated as described above for each tree species separately. For more accurate measurements for research purposes a large number of heights are measured to compile curve heights.

11.3.2.3 Estimation and Models

The data on the number of stems by age class and tree species, and height grades are carried in a form, called the "muster list". After calculating the volume of the stems from the volume table, aboveground stems in dbh class is derived. The dbh class is multiplied by the number of stems in the extent and collected, give the whole volume of the callipered stand. The classification of timber according to assortment category and class of assortments is presented in Table 11.9.

Table 11.9 Classification of timber according category of assortments and class of assortments

Category of assortment	Class of assortment	Assortment size	
		Diameter at the small end (for deciduous with bark) cm	Maximum length (m)
Large industrial timber	Ia	50 and up	4; 5
	I	From 30 to 49	4; 5
	II	From 18 to 29	4; 5
Mean industrial timber	III	From 15 to 17	3; 4; 5
	IV	From 11 to 14	3; 4; 5
	V	From 5 to 10	3; 4; 5
Small industrial timber	VI	From 3 to 7	2; 3

11.3.3   Assessment of Change

11.3.3.1   Assessment and Measurement

The estimation of stock and volume of assortments is based on the field measurements and the use of different methods (full calipering, mathematic-statistical methods, table methods, etc.). Species specific assortment and volume tables are used.

11.3.3.2   Estimation of Increment

The current increment of callipered stands is calculated using increment tables or indirectly by the formula of Schneider (Chapman 1921).

11.3.3.3   Estimation of Drain

Cuttings and removals are estimated using official removal statistics collected and published every year from national statistic. Before the inventory and elaboration of Forest Management Plan (every 10 years) the volume and structure of cuttings and removals are received from forest enterprise and are analysed.

11.3.4   Other Wooded Land and Trees Outside Forests

The trees on other wooded land and trees outside forests are not subject of the forest development inventories in Bulgaria.

References

Biodiversity Act, Prom. SG. 77 of 9 Aug 2002
Chapman HH (1921) Forest mensuration. Wiley, New York
FAO (2010) Global Forest Resources Assessment 2010. Forest Resources Assessment Programme Working Paper 163. FAO Forestry Department, Rome
Protected Areas Act, Prom. SG. 133 of 11 Nov 1998
Raykov R (2006) 105 years forest management in Bulgaria, Highly qualified, experience and reputation. Forest Magazine 3
Republic of Bulgaria National Statistic Institute (2012) Regions, districts and municipalities in the Republic of Bulgaria, Sofia
Republic of Bulgaria National Statistic Institute (2012) Statistical yearbook 2011, Sofia
The Forests Act, in force from 09.04.2011, Prom. SG. No. 19 of 8 Mar 2011