**Republika e Kosovës**
**Republika Kosova-Republic of Kosovo**
*Qeveria –Vlada-Government*

**MINISTRIA BUJQËSISË, PYLLTARISË DHE ZHVILLIMIT RURAL**
**MINISTARSTVO POLJOPRIVREDE, SUMARSTVA I RURALNOG RAZVOJA**
**MINISTRY OF AGRICULTURE, FORESTRY AND RURAL DEVELOPMENT**






# Kosovo National Forest Inventory 2012

***Pristina, 2013***

| |
|---|
| *Albansk…* |
| *Serbisk…* |
| *The work behind this document has been financed by the Government of Norway. Owner of the report is the Kosovo Ministry of Agriculture, Forestry and Rural Development. Responsibility for the contents rests entirely with the authors.*<br>*Authors: Dr. Stein M. Tomter, Erling Bergsaker, Ibrahim Muja, Tormod Dale and Jens Kolstad*<br>*Editor: Tormod Dale*<br>*Reviewer: Lars S. Dalen*<br>*Photo: Erling Bergsaker, Orhan Berisha, Tormod Dale*<br>*Illustration: Orhan Berisha, Jens Kolstad, Kristina Moen, Stein M. Tomter*<br>*Translation: Ibrahim Muja and Dr. Nenad Petrovic*<br>*Layout: Kristina Moen, Norwegian Forestry Group*<br>*Print: Xhad Studio, Pristina*<br><br>*Recommended citation: Tomter S. M., Bergsaker E., Muja I., Dale T. and Kolstad J. 2013. Kosovo National Forest Inventory 2012. Kosovo Ministry of Agriculture, Forestry and Rural Development/Norwegian Forestry Group.* |

NFG
NORWEGIAN FORESTRY GROUP

# Foreword

This report documents a major achievement in the history of forestry in Kosovo. For the first time, all Kosovo have been surveyed.

The National Forest Inventory gives us the first confident information about wood harvesting in our country, based on field assessments. We now have a better understanding of forest conditions, development and level of harvesting.

It is of national strategic interest to any country to monitor increment and drain of wood. This information will help investors, who are searching for business opportunities in wood-based industries. What kind of products can be manufactured from our wood? What kind of processing technology is required? As we become more integrated with Europe, our neighbors and international partners are interested in how we perform in the broader regional and European context.

The National Forest Inventory was prepared and carried out by the project "*Forest Management Planning with GIS*", which is implemented by Norwegian Forestry Group in cooperation with Kosovo Forest Agency. The Government of Norway sponsored the work. Kosovo Forest Agency has contributed the staff necessary to conduct the fieldwork. My appreciation goes to all the contributors to this work, including the 12 fieldworkers that for a six month period collected forest information throughout Kosovo, often in remote areas and steep terrain.

Mr. Hysen Abasi

Head of Department of Forestry
Kosovo Ministry of Agriculture, Forestry and Rural development

# Summary

Kosovo's second National Forest Inventory (NFI) was carried out in 2012/2013, ten years after the first. Using a method called systematic sample plot inventory and combining remote sensing technology and traditional field assessment, 12 foresters visited and assessed 1 860 sample plots throughout the territory during a six months period. For the first time the entire forest area have been assessed.

The purpose of NFI is to provide information for the government to helping develop the forest sector, to assess forest management sustainability and to fulfill potential international reporting obligations in the land use-, land use change- and forestry sectors.

This report is organized according to the 6 agreed upon quantitative criteria and associated reporting indicators for sustainable forest management in Europe. How results compare with those of other countries in South East Europe is included.

Forest area in Kosovo is fairly stable at approximately 481 000 ha (44.7% of total area). Some cropland may have been converted to grasslands and settlements, but this is impossible to state with certainty since a large unclassified area, due to accessibility restrictions and lack of data in 2003, now have been classified. 38% of the forest area is privately owned, whereas 62% is public forest. Coppice forest dominates the forest area with 84%. Pure broadleaved forests cover almost 83% of the forest area.

Growing stock of trees with diameter at breast height >= 7 cm stands at 40.5 million $m^3$, about the same as ten years ago. Amongst the trees, *Fagus* species contribute 46% of the volume, whereas *Quercus* species represent 23%. Mean growing stock in Kosovo is 84 $m^3$/ha.

Annual increment over bark of trees with diameter (dbh) >= 7 cm is estimated at 1.55 million $m^3$ – 1.32 million of broadleaves and 0.23 million of coniferous trees. Maximum long-term annual felling strictly from a productivity point of view is at the order of 1.45 million $m^3$. This is a gross figure and should be reduced due to harvesting losses, natural losses and environmental considerations. Net maximum long-term harvesting level for Kosovo is at the level of 1.2 million $m^3$. This estimate should be further reduced due to areas unavailable for wood supply, including National Parks.

An analysis performed on 60% of the forest area documents that harvesting of an average 950 000 $m^3$ every year have taken place. Consequently, annual harvest may roughly be estimated at 1.6 million $m^3$. Only a small fraction of the harvesting (7%) is carried out according to forest legislation. At national level it seems that annual removals and natural losses of wood are balanced by gross annual increment. Based on the share of degraded high forest and results from recent forest management planning, in certain areas over-harvesting have taken place.

Since 2006, development of new cost-efficient forest management plans (FMPs) has been a priority for the Kosovo government. A total of 39 new management plans have been prepared. Almost half the forest management units will have new plans by the end of 2013.The forest management

planning method includes classification of forest stands according to management classes. During the NFI this classification was also applied on the sample plots, providing overall statistics for Kosovo.

Kosovo forests are tree species rich. 132 000 ha (27.5%) of the forest area is stocked with four or more species. Almost the entire forest area (99%) shows some kind of human influence. Sharri- and Bjeshket e Nemuna national parks have been designated as protected areas by the government. As much as 90% of growing stock in coniferous forest and 91% in mixed coniferous/broadleaved forest are located within the park. Forest management with the objective of wood production will be possible within defined zones representing the major parts of the parks.

Kosovo's forest is neither a source nor a sink of the greenhouse gas carbon dioxide. This is because a quantity equivalent to the annual increment of woody biomass sequestering carbon, is being removed every year and most of it burnt as firewood. Through the combustion process, carbon is released into the atmosphere.

Fire is the most significant disturbance to forest stands. An area of 12 200 ha, or 2.5% of total forest area was found to be seriously affected by fire. For the forest owners, this is an economic loss. 14.5 % of growing stock has some kind of damage. However, in many cases these damages will not reduce vitality in the long run. Biotic and abiotic disturbances are part of a healthy forest ecosystem.



# INTRODUCTION

The main objective of Kosovo's National Forest Inventory (NFI) is to promote a sustainable forest management by assessing the total forest resources and the annual sustainable harvest level. The first country-wide forest inventory was carried out in 2002-2003 through UN Food and Agriculture Organisation (FAO), and implemented by Norwegian Forestry Group (NFG). In 2010 the Ministry of Agriculture, Forestry and Rural Development (MAFRD) requested an update of Kosovo's National Forest Inventory – ten years after the first. In the *Policy and Strategy Paper on Forestry Sector Development in Kosovo 2010 – 2020*, it is stated:

"*Accurate information about the status of the forest resources shall always be available. In particular the policy of the Government is to establish and maintain permanent resources for national forest inventories. This information will provide data for monitoring of the forest resource base, policy making and strategic planning by central forest authorities, to safeguard the use of wood products in harmony with the development of the forest resource base."*

The main objectives of the second NFI for Kosovo are:

- Providing valid forest statistics on land use and land use change
- Producing valid forest statistics on the status and change in growing stock, wood increment, and carbon stocks for national planning and international reporting
- Maintaining and strengthening forest assessment know-how

***Why a National Forest Inventory?***

National Forest Inventories are useful for several purposes:

- Helping policy makers in developing the forest sector
- Assessing the balance between forest drain and increment
- Assessing availability of wood raw materials (investors)
- Establishing appropriate processing capacity and technology to best meet market demands for products

NFI data are important to Kosovo's potential future international reporting obligations. Both the FAO Global Forest Resources Assessment and the regional Ministerial Conference on the Protection of Forests in Europe (FOREST EUROPE) require country level forest information.

Kosovo's future international reporting needs can be grouped into three categories:

1. Assessments carried out by FAO, such as the Global Forest Resources Assessment, the Global Planted Forest Thematic Supplement and the Questionnaire on Forest Degradation.
2. Climate changes. Kosovo is not yet a signatory to the UN Framework Convention on Climate Change (1993), and the Kyoto Protocol (2004). However, as a potential so-called non-Annex 1 country, Kosovo would be required to provide some information on its carbon emissions and sinks from various sectors, including land use, land use change and forestry.

3. Regional processes on criteria and indicators for sustainable forest management (FOREST EUROPE). The process identified six criteria, each with a set of quantitative indicators for monitoring, evaluating and reporting on progress towards sustainable forest management at the national level.




**Figure 1: Overview map of Kosovo**

This report is organized according to the agreed upon six criteria for sustainable forest management in Europe. The fulfillment of the criteria can be evaluated through a set of 35 quantitative indicators.

**Table: 1 Criteria and indicators for sustainable forest management in Europe**

| Criterion | Indicator | Explanation | Addressed by NFI |
|---|---|---|---|
| C1: Maintenance and Appropriate Enhancement of Forest Resources and their Contribution to Global Carbon Cycles | 1.1 Forest area | Area of forest and other wooded land, classified by forest type and by availability for wood supply, and share of forest and other wooded land in total land area | X |
| | 1.2 Growing Stock | Growing stock on forest and other wooded land, classified by forest type and by availability for wood supply | X |
| | 1.3 Age structure and/or diameter distribution | Age structure and/or diameter distribution of forest and other wooded land, classified by forest type and by availability for wood supply | X |
| | 1.4 Carbon Stock | Carbon stock of woody biomass and of soils on forest and other wooded land | X |
| C2: Forests Ecosystems Health and Vitality | 2.1 Deposition of air pollutants | Deposition of air pollutants on forest and other wooded land, classified by N, S and base cations | |
| | 2.2 Soil condition | Chemical soil properties (pH, CEC, C/N, organic C, base saturation) on forest and other wooded land related to soil acidity and eutrophication, classified by main soil types | |
| | 2.3 Defoliation | Defoliation of one or more main tree species on forest and other wooded land in each of the defoliation classes “moderate”, “severe” and “dead” | |
| | 2.4 Forest damage | Forest and other wooded land with damage, classified by primary damaging agent (abiotic, biotic and human induced) and by forest type | X |
| C3: Maintenance and Encouragement of Productive Functions of Forests | 3.1 Increment and fellings | Balance between net annual increment and annual fellings of wood on forest available for wood supply | X |
| | 3.2 Roundwood | Value and quantity of marketed roundwood | |
| | 3.3 Non-wood goods | Value and quantity of marketed non-wood goods from forest and other wooded land | |
| | 3.4 Services | Value of marketed services on forest and other wooded land | |
| | 3.5 Forests under management plans | Proportion of forest and other wooded land under a management plan or equivalent | X |
| C4: Maintenance, Conservation and Appropriate Enhancement of Biological Diversity in Forest Ecosystems | 4.1 Tree species composition | Area of forest and other wooded land, classified by number of tree species occurring and by forest type | X |
| | 4.2 Regeneration | Area of regeneration within even-aged stands and uneven-aged stands, classified by regeneration type | |
| | 4.3 Naturalness | Area of forest and other wooded land, classified by “undisturbed by man”, by “semi-natural” or by “plantations”, each by forest type | X |
| | 4.4 Introduced tree species | Area of forest and other wooded land dominated by introduced tree species | X |
| | 4.5 Deadwood | Volume of standing deadwood and of lying deadwood on forest and other wooded land classified by forest type | X |
| | 4.6 Genetic resources | Area managed for conservation and utilisation of forest tree genetic resources (in situ and ex situ gene conservation) and area managed for seed production | |
| | 4.7 Landscape pattern | Landscape-level spatial pattern of forest cover | |
| | 4.8 Threatened forest species | Number of threatened forest species, classified according to IUCN Red List categories in relation to total number of forest species | |
| | 4.9 Protected forests | Area of forest and other wooded land protected to conserve biodiversity, landscapes and specific natural | X |

| Criterion | Indicator | Explanation | Addressed by NFI |
|---|---|---|---|
| | | elements, according to MCPFE Assessment Guidelines | |
| C5: Maintenance and Encouragement of Protective Functions of Forests | 5.1 Protective forests – soil, water and other ecosystem functions | Area of forest and other wooded land designated to prevent soil erosion, to preserve water resources, or to maintain other forest ecosystem functions, part of MCPFE Class "Protective Functions" | |
| | 5.2 Protective forests – infrastructure and managed natural resources | Area of forest and other wooded land designated to protect infrastructure and managed natural resources against natural hazards, part of MCPFE Class "Protective Functions" | |
| C6: Maintenance and Enhancement of Socio-economic Functions and Conditions | 6.1 Forest holdings | Number of forest holdings, classified by ownership categories and size classes | X |
| | 6.2 Contribution of forest sector to GDP | Contribution of forestry and manufacturing of wood and paper products to gross domestic product | |
| | 6.3 Net revenue | Net revenue of forest enterprises | |
| | 6.4 Expenditures for services | Total expenditures for long-term sustainable services from forests | |
| | 6.5 Forest sector workforce | Number of persons employed and labour input in the forest sector, classified by gender and age group, education and job characteristics | |
| | 6.6 Occupational safety and health | Frequency of occupational accidents and occupational diseases in forestry | |
| | 6.7 Wood consumption | Consumption per head of wood and products derived from wood | |
| | 6.8 Trade in wood | Imports and exports of wood and products derived from wood | |
| | 6.9 Energy from wood resources | Share of wood energy in total energy consumption, classified by origin of wood | |
| | 6.10 Accessibility for recreation | Area of forest and other wooded land where public has a right of access for recreational purposes and indication of intensity of use | |
| | 6.11 Cultural and spiritual values | Number of sites within forest and other wooded land designated as having cultural or spiritual values | |

According to the report State of Europe's Forests (FOREST EUROPE, UNECE and FAO 2011), most of the South-East European countries are lacking adequate forest sector information, and therefore it is "not possible to say with any objectivity whether or not forest management is sustainable." Through its National Forest Inventory, Kosovo is contributing to improved information on a number of the specific challenges listed.

Support for NFI, Kosovo Forest Agency (KFA) and MAFRD come from the Norwegian Ministry of Foreign Affairs, to further strengthen competence building in forest assessment, forest management and forest information management. The NFI is implemented by Norwegian Forestry Group in cooperation with Kosovo Forest Agency through the project *Forest Management Planning with Geographic Information Systems*.

# INVENTORY SYSTEM

*A National Forest Inventory gives an independent overview for the current forest situation of the country. The information is based on a grid of sample plots, systematically distributed all over the country. The sample plots are first assessed and classified for land use, by using aerial images. All sample plots that might contain forest or other wooded land, are visited in the field. For all plots visited, the forest condition is assessed in details. The sample plots are permanent, which mean that the exact same plots in principle are measured at regular intervals, often every 5 years. This gives an excellent basis for monitoring growth, health and other attributes. For all Kosovo there are 3 453 plots. Of these, 1 860 plots were visited in the field.*

## Sampling design

The national forest inventory (NFI) consists of a grid of 4 x 4 km across all of Kosovo. In order to improve the accuracy of the inventory in areas with an expected higher proportion of valuable forest, the density of the grid was increased to 2 x 4 km.

The sampling areas consist of four circular plots 200 meters apart placed at each grid intersection.

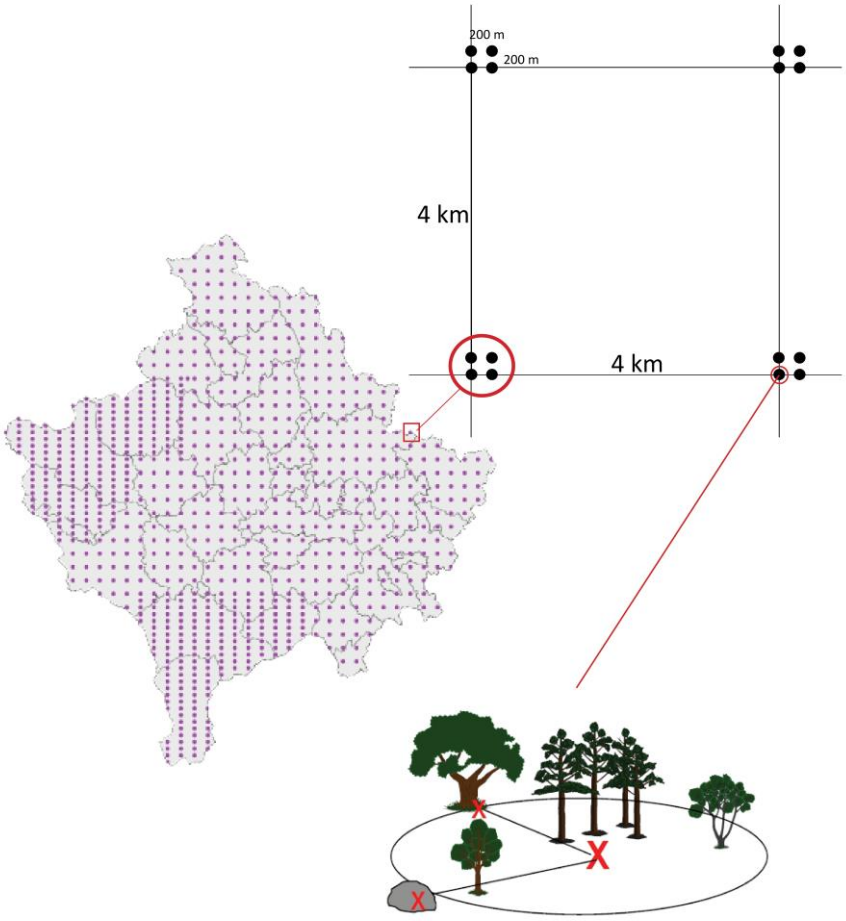



Figure 2: Sampling design for the Kosovo National Forest Inventory

In order to establish an efficient forest inventory, the NFI combines new and traditional methodology. Geographic information system for remote sensing and spatial data management was used in combination with traditional forest assessment and forest mensuration tools and techniques.

Aerial photography was used for an initial classification in order to identify the forested plots requiring field measurements and facilitating a rough classification of the forest.

Sample plots assigned to the classes “Forest” or “Other wooded land” (see definition in appendix 1) should in principle be selected for field measurements. From the beginning, it was expected that it would be impossible to visit all the plot locations in the field. Photo interpretation made it possible to establish a total land use class distribution for Kosovo.

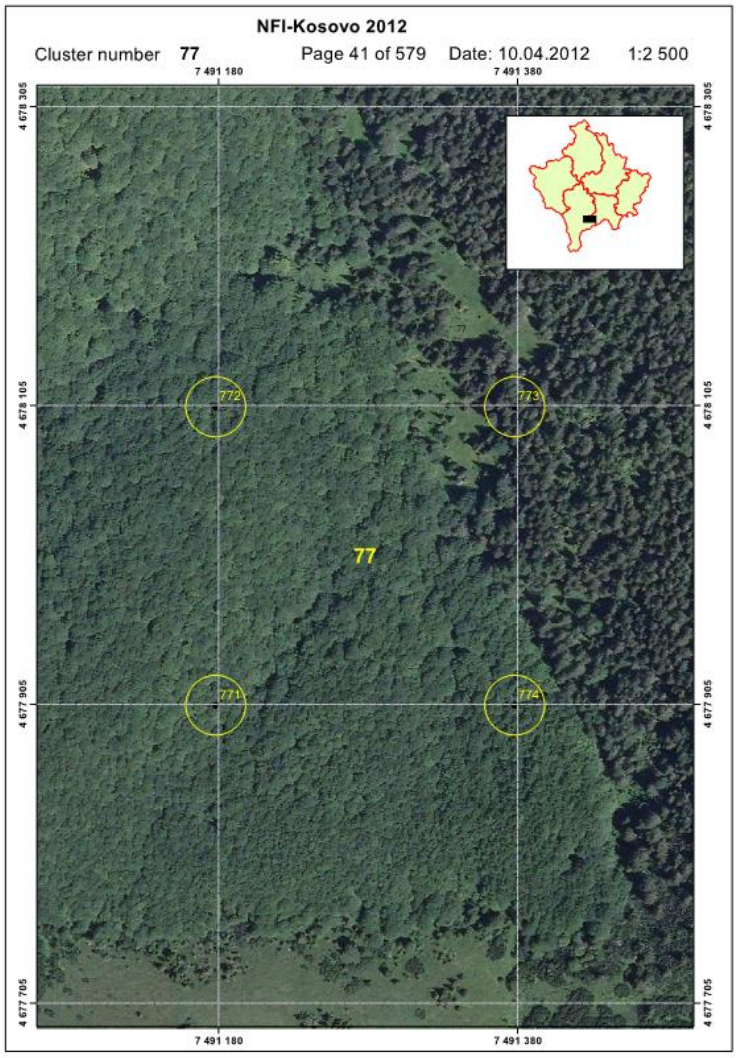



Figure 3: Ortophoto showing one cluster of four sample plots 200 meter x 200 meter apart for use in fieldwork

The permanent sample plots established in 2002-2003 were revisited in 2012, enabling confident estimates of trends in growing stock. Using data from the first NFI, amongst other tree species, azimuth and distance from the plot center to each tree, field workers were able to identify the sample plots, and re-measure the exact same trees. Measuring the same trees over time provides valid statistics on increment, harvesting and natural losses.



Figure 3: Metal stick from NFI 2002 for permanent establishment of sample plot

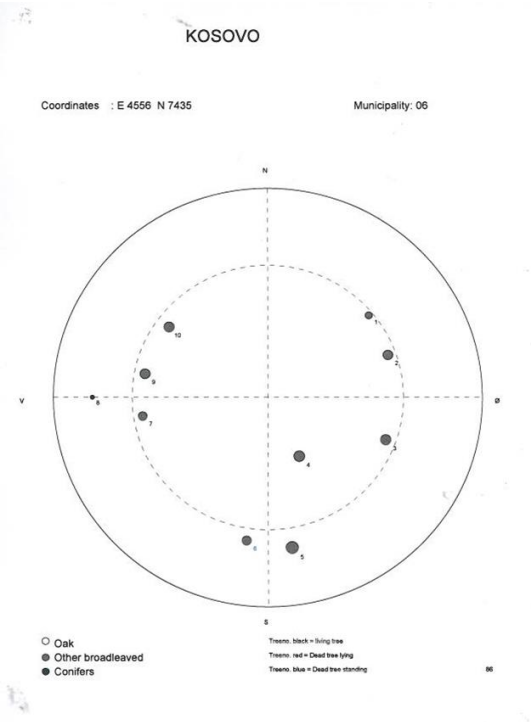



Figure 4: Position of trees on sample plot based on azimuth, distance and other NFI 2002 data



Figure 5: Trees numbered for secure identification and detailed measurement

## Measurements and assessments

The NFI fieldwork was carried out during a six-month period in 2012 by 12 professionals divided into six field teams.

*Table 2: Fieldworkers in the NFI 2012*

| Team leader | Field assistant |
|---|---|
| Orhan Berisha (field coordinator) | Esat Dautaj |
| Branko Bojovic | Slobodan Jelenic |
| Rrustem Dautaj | Beqe Mehmetaj |
| Fitim Hoxhaj | Agron Shkodra |
| Osman Hasani | Ekrem Krasniqi |
| Bedri Beluli | Shkodran Krasniqi |

The circular permanent sample plots consists of an inner circle with radius 2,5 meter, mainly for assessment of regeneration and small trees, a main circle with radius 10 meter for measurements of trees with diameter at breast height >= 7 cm and an outer circle with radius 20 meter, mainly for stand condition assessments.

Using GPS receivers, the field workers were able to accurately navigate to the pre-defined sample plot centre. A metal rod was placed discreetly in the centre of each sample plot in order to be physically recognizable by future NFI field workers. The markers are not visible to passersby, assuring that the sample plots are treated similarly to other forest areas nearby. This provides a more correct estimate of forest usage over time.



The NFI measures tree diameter of all living and dead trees on the sample plot in addition to height measurements on a sub-sample of the trees. Furthermore, the list of attributes comprised the most important for assessing the extent, structure and quality of forest resources for international and national purposes. All field data were recorded in forms made available in both Albanian and Serbian (see field record forms in appendix 2).

Figure 6: Fieldworker measuring diameter of tree

*Table 3: Selected attributes included in the NFI (see appendix 1 for details)*

| Assessment | Attribute |
|---|---|
| Stand | Stand age |
| | Stand origin |
| | Origin of small trees/regeneration |
| | Stand structure |
| | Treatment opportunity |
| | Tree species composition |
| | Naturalness |
| | Occurrence of junipers |
| Tree | Tree species |
| | Tree status |
| | Diameter at breast height (dbh) |
| | Tree height |
| | Azimuth from plot center to tree |
| | Distance from plot center to tree |
| | Cause of damage |
| | Tree quality |

1 502 sample plots in forest were assessed in detail during the 2012 fieldwork. For 921 of these, the centre established in 2002 were found and the exact same trees were re-measured, enabling an analysis on development.

## Calculations

All field data were continuously stored in a Microsoft Access database, using ArcPad software interface for the record form transfer. Consistency checks of the geographical distribution were done using ArcGIS, and the analysis of the numerical data was done using SAS-software.

Individual tree volume estimation was performed using the tables created by ***Drinić, Matić, Pavlič, Prolić, Stojanović, Vukmirović and Koprivica (1990): Tablice taksacionih elemenata visokih i izdanačkih šuma u Bosni I Hercegovini.***

In the 2002 NFI, the mathematical functions to be included in a computer program, were created through regression analysis . These functions were reused in this NFI.

Volume estimation for high forest is carried out in two steps: First, establishing a specific site quality class, and second estimating tree volume. Drinic et al. (1990) has established strong relationships between diameter at breast height and total tree height. For each of the tree species, five such curves have been established, each defining a specific site quality class. Based on known diameter and height of the sample trees, an estimated average site quality class for each sample plot has been calculated. With the known site quality class, volume can be estimated using functions with only diameter at breast height as an independent variable.



Figure 7: Fieldworkers measuring height of sample trees using Vertex hypsometer (left) with transponder (right)

Because the site quality class tables and functions are not available for broadleaved trees in coppice forests, volume functions for oak and beech were established using (Drinic et al. 1990). These could only be directly applied for sample trees with complete set of measurements. Common height curves based on all sample trees in coppice forest were calculated, to make it possible to estimate tree heights and to apply the volume functions also for trees where only diameter was known (Tomter 2003).

Increment functions were created by regression analysis during the NFI 2002. Measurements of width of the ten most recent annual growth rings (ten years growth) were done on a bore core extracted from sample trees. Functions were generated for the main tree species groups.

## How reliable are the results?

Only the sampling error of the inventory can be estimated. In addition there are error components due to inaccurate area classification, tree measurements et cetera. It has not been possible to quantify the magnitude of the measurement errors and the assessment errors. A check assessment of a smaller sub-sample of sample plots revealed some variability between field workers regarding stand classification, but tree measurements were fairly accurate.

There is no exact method for calculating the standard errors in a systematic sampling such as the NFI. By applying the standard formula for random sampling it is possible to estimate the standard error of volume per hectare $S\%/\sqrt{n}=4.3\%$.[1]

[1] S= Standard error of the mean estimate at plot level, n=number of plots.

Assuming that the total number of sample plots represents the total area of Kosovo, and that the surveyed forest area constitutes 45% of the total area, the estimated standard error of the surveyed forest area would be about 1.9%. Taken together, the two error components (volume per ha and area), add up to about 4.7%[2].

[2] Formula for calculation of the two error components (volume and area): $\sqrt{4{,}3^2 + 1{,}9^2}$ = 4,7%

# Main results

The main NFI results are presented in tables and diagrams. A comparison with the situation in other South-East European countries has been made for some parameters.

## Land use

Land use distribution is calculated based on classification of the 3 453 sample plots for Kosovo. Results are presented below.

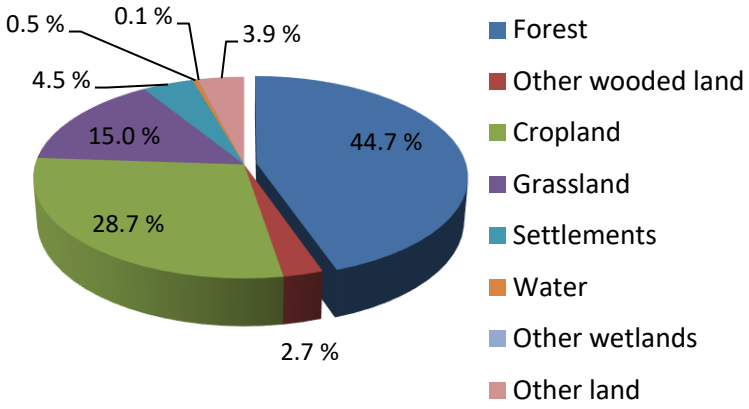



Figure 1: Land use classes in Kosovo (% of total land area)

*Table: Development of total area by land use classes.*

| Land use classes | 2002 | | 2012 | |
|---|---|---|---|---|
| | ha | % | ha | % |
| Forest | 460 800 | 42,1 | 481 000 | 44,7 |
| Other wooded land | 28 200 | 2,6 | 29 200 | 2,7 |
| Cropland | 342 400 | 31,3 | 309 000 | 28,7 |
| Grassland | 153 200 | 14,0 | 161 400 | 15,0 |
| Settlements | 40 000 | 3,7 | 48 000 | 4,5 |
| Water | 4 600 | 0,4 | 5 200 | 0,5 |
| Other wetlands | | | 800 | 0,1 |
| Other land | 23 400 | 2,1 | 42 400 | 3,9 |
| Not classified | 41 600 | 3,8 | 0 | 0,0 |
| **Total** | **1 094 200** | **100** | **1 077 000** | **100** |

Kosovo's official land area is 1 090 800 ha. The discrepancy between this figure and the total area listed in Table # is partly due to sample plots located outside Kosovo that were erroneously included in the 2002 NFI.

Kosovo's forest area has increased by 5%  (20 200 ha) in the period 2002-2012. In the same period cropland area has decreased, perhaps explaining the increase in forest area by cropland conversion to forest and settlements. The increase in settlements (8 000 ha) is most likely a result of an increased demand for housing and industrial development.

In the 2002 NFI a large number of sample plots near the Serbian border were inaccessible and classified using aerial photography only.



Figure: Rural settlements with surrounding cropland and forest, Leposavic

## Forest resources

### Forest area

Forest area is defined as land with tree crown cover of more than 10% and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 meter at maturity *in situ* (see appendix 1 for the full definition), which is the international FAO definition.

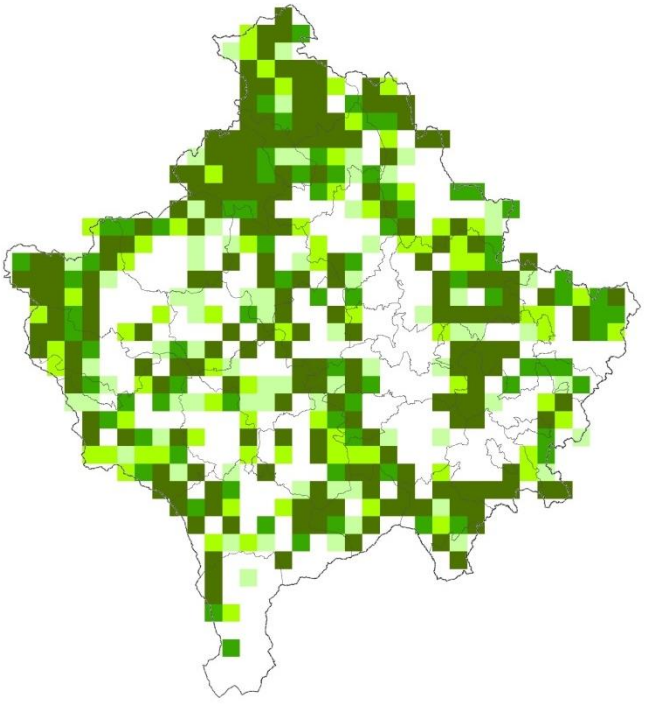


Figure 2: Classification of clusters based on distribution of sample plots classified as forest. Graduation of green color is according to number of sample plots in one cluster classified as forest. Darkest green is shown where all 4 plots in one cluster are forest.

*Table: Forest area by forest composition and stand structure (ha)*

| **Forest composition** | **Stand structure** | | | | **Total** |
|---|---|---|---|---|---|
| | Regeneration | Even-aged | Two-storied | Uneven-aged | |
| Coniferous | 2 200 | 6 600 | 6 200 | 8 800 | 23 800 |
| Mixed | 0 | 400 | 3 200 | 4 200 | 7 800 |
| Broadleaved | 45 400 | 236 000 | 123 600 | 44 400 | 449 400 |
| **Total** | 47 600 | 243 000 | 133 000 | 57 400 | **481 000** |

Kosovo forests are dominated by broadleaved trees, covering 93% (449 400 ha; Table #). More than half of this forest is considered even-aged. Coniferous forests cover almost 5% of the forest area (23 800 ha), and is evenly distributed between the various structure classes. The pine plantations contribute to the even-aged area. In total, 50% of the forest area is considered even-aged.

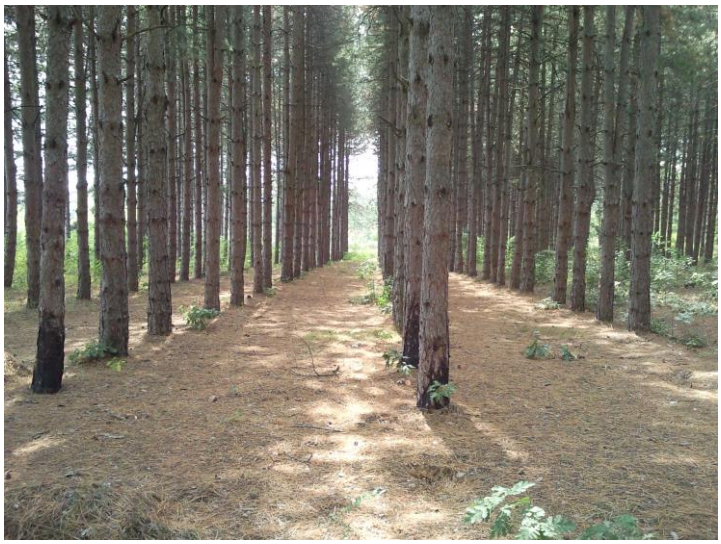


Figure: Pine (*Pinus nigra*) plantation in Kosovo

Half of Europe's forest is covered by conifers. The composition of Europe's forest has been stable for the last periods. But the forest cover has increased all over Europe since 1990, except for Russia, making Europe the only region in the world with growth in forest area the last 20 years. South-East Europe is the least forested region in Europe. It is also the region with the lowest reported share of forest available for wood supply, perhaps due to difficult access in mountainous areas.

*Table: Forest area by stand origin and ownership (ha)*

| Stand origin | Ownership | | | Total |
|---|---|---|---|---|
| | Public | Private | Unknown | |
| Natural seeding | 58 400 | 13 600 | 1 000 | **73 000** |
| Planting and artificial seeding | 2 000 | 800 | 0 | **2 800** |
| Coppice | 229 000 | 164 800 | 4 000 | **397 800** |
| Coppice with standards | 5 800 | 1 600 | 0 | **7 400** |
| Total | **295 200** | **180 800** | **5 000** | **481 000** |

A total of 180 800 ha (38%) of Kosovo's forest is classified as privately owned, and 295 200 ha (62%) classified as public forest. Coppice forest covers 84 percent of the total forest area. This is a result of extensive harvesting, in particular by short rotation coppice forestry for firewood production. The forest which regenerates naturally is normally beech (*Fagus* spp.), mixed beech and conifers, and pure coniferous forests located at higher elevations.

## Age distribution

Age distribution explains the history of the forest, how it has been regenerated, how it has developed over the years, and also, how it probably will look in the future, i.e. future harvesting potential. Knowledge about age distribution can also provide information about biodiversity and the forest's recreational values.

*Table: Forest area by forest composition and age class (ha)*

| Forest composition | Age class (years) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0-20 | 21-40 | 41-80 | 81-120 | 121-160 | 161-200 | **Total** |
| Coniferous | 4 600 | 3 600 | 11 400 | 3 400 | 800 | 0 | **23 800** |
| Mixed | 200 | 1 000 | 4 600 | 1 200 | 600 | 200 | **7 800** |
| Broadleaved | 139 600 | 157 200 | 127 800 | 21 800 | 2 800 | 200 | **449 400** |
| **Total** | **144 400** | **161 800** | **143 800** | **26 400** | **4 200** | **400** | **481 000** |

The age of uneven-aged forest is measured using the dominant upper-canopy level. The oldest forest in Kosovo is uneven-aged, and a relatively small area is old forest. No forest older than 200 years has been identified.

*Table: Even-aged forest area by forest composition and age class (ha)*

| Forest composition | Age class | | | | | Total |
|---|---|---|---|---|---|---|
| | 0-20 | 21-40 | 41-80 | 81-120 | 121-160 | |
| Coniferous | 2 200 | 1 400 | 2 400 | 400 | 200 | **6 600** |
| Mixed | 0 | 0 | 400 | 0 | 0 | **400** |
| Broadleaved | 76 600 | 97 000 | 54 000 | 8 400 | 0 | **235 400** |
| **Total** | **78 800** | **98 400** | **56 800** | **8 800** | **200** | **243 000** |

Age class distribution of even-aged forests is important for forest management. There is a distinct difference between coniferous and broadleaved forest; the vast area of broadleaved coppice forests managed for short rotation firewood production contributes to the large area in younger age classes.

In South-East Europe the proportion of old even- aged and uneven-aged forest together has been fairly stable, at slightly above 25 percent of the total forest area, during the last 20 years; even-aged forest between 20 and 80 years old constitutes the dominant part of the forest area (>60 %).

## Growing stock

Growing stock, both in cubic meters and stocking levels ($m^3$/ha), is an important indicator(s) for assessing sustainable forest management. Volumes in this report are given in cubic meter over bark.

*Table: Growing stock in forest by main tree species (dbh >= 7 cm, 1000 $m^3$)*

| Tree species | 2002 | 2012 |
|---|---|---|
| *Quercus cerris* | 5 170 | 4 282 |
| *Querus petrea* | 4 276 | 3 669 |
| *Other quercus sp.* | 129 | 1 292 |
| *Fagus sp.* | 15 963 | 18 524 |
| Other broadleaves | 3 704 | 6 750 |
| Undefined broadleaves | 5 983 | 0 |
| *Abies alba* | 1 577 | 1 573 |
| *Picea abies* | 1 402 | 1 840 |
| *Pinus sp.* | 2 018 | 2 502 |
| Other conifers | 223 | 77 |
| **Total** | **40 445** | **40 508** |

Total growing stock has not changed much since 2002. The growing stock of the most valuable tree species for the high forest is either stable or increasing.

Assuming the forest area is fairly stable this indicates that annual increment is balanced by annual harvesting and natural losses.



Figure 3: Beech forest in Kosovo

*Table: Growing stock by main tree species group and forest and other wooded land (1000 $m^3$)*

| Tree species group | 2002 | | 2012 | |
|---|---|---|---|---|
| | Forest | Other wooded land | Forest | Other wooded land |
| Coniferous | 5 220 | 2 | 5 992 | 0 |
| Broadleaved | 35 225 | 9 | 34 516 | 14 |
| Sub-total | 40 445 | 11 | 40 508 | 14 |
| | | | | |
| Coniferous <7cm | | | 88 | 21 |
| Broadleaved <7cm | | | 5 735 | 107 |
| Sub-total | | | 5 823 | 128 |
| **Total** | | | **46 331** | **142** |

Estimations of growing stock are more uncertain for the small trees, as data are based on counting and not individual tree measurement.

*Table: Growing stock in forest by tree species and diameter class (1000 $m^3$)*

| Tree species | Diameter class | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 7-10 | 10 -20 | 20 -30 | 30 -50 | 50 -70 | 70 - | |
| *Quercus cerris* | 592 | 1 686 | 923 | 872 | 127 | 83 | 4 282 |
| *Querus petrea* | 365 | 1 539 | 880 | 644 | 169 | 72 | 3 669 |
| *Other quercus sp.* | 245 | 646 | 164 | 57 | 143 | 37 | 1 292 |
| *Fagus sp.* | 494 | 2 559 | 3 077 | 6 244 | 3 840 | 2 311 | 18 524 |
| Other broadleaves | 883 | 2 274 | 1 233 | 1 246 | 372 | 742 | 6 750 |
| *Abies alba* | 34 | 216 | 364 | 660 | 183 | 117 | 1 573 |
| *Picea abies* | 45 | 286 | 487 | 829 | 193 | 0 | 1 840 |
| *Pinus sp.* | 28 | 181 | 468 | 1 195 | 472 | 159 | 2 502 |
| Other conifers | 2 | 10 | 8 | 57 | 0 | 0 | 77 |
| **Total** | 2 688 | 9 397 | 7 604 | 11 804 | 5 499 | 3 521 | **40 508** |

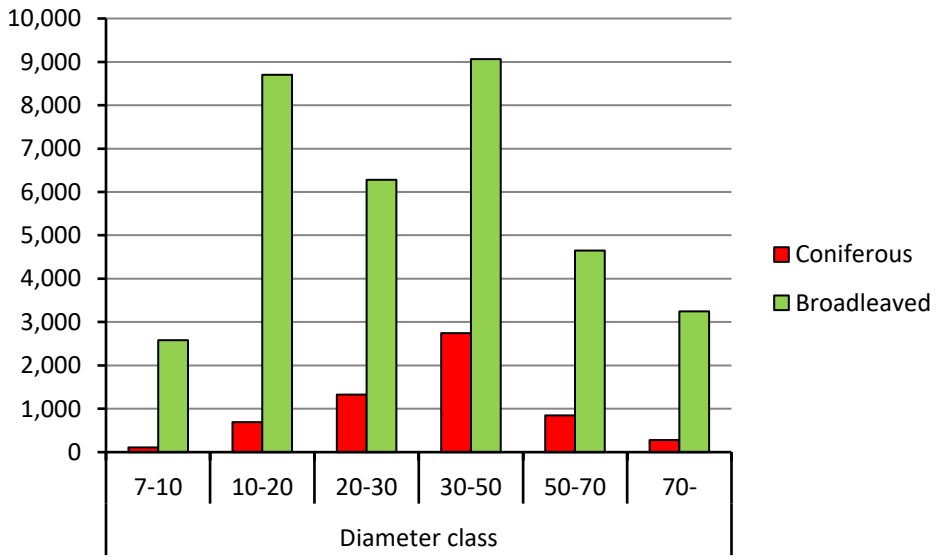


Figure 4: Growing stock in forest by tree species group and diameter class (1000 $m^3$)

The large scale short rotation coppice forestry contributes to broadleaves big share of growing stock in diameter class 10-20 cm. For coniferous species, the growing stock is statistically more "normally" distributed across diameter classes.

*Table: Growing stock in forest by tree species and elevation class (1000 $m^3$, meter)*

| Tree species | Elevation class | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | *<500* | *500-750* | *750-1000* | *1000-1250* | *1250-1500* | *>=1500* | |
| *Quercus cerris* | 316 | 2 027 | 1 538 | 383 | 18 | 0 | 4 282 |
| *Quercus petrae* | 169 | 913 | 2 224 | 326 | 11 | 25 | 3 669 |
| Other *Quercus* sp. | 52 | 570 | 655 | 13 | 0 | 2 | 1 292 |
| *Fagus* sp. | 67 | 630 | 3 415 | 7 083 | 5 238 | 2 090 | 18 524 |
| Other broadleaves | 901 | 1 259 | 2 411 | 1 593 | 328 | 257 | 6 750 |
| *Abies alba* | 0 | 0 | 8 | 216 | 586 | 762 | 1 573 |
| *Picea Abies* | 0 | 16 | 10 | 92 | 277 | 1 446 | 1 840 |
| *Pinus* sp. | 109 | 127 | 4 | 69 | 254 | 1 938 | 2 502 |
| Other conifers | 49 | 1 | 22 | 5 | 0 | 0 | 77 |
| **Total** | 1 663 | 5 543 | 10 287 | 9 780 | 6 712 | 6 520 | **40 508** |

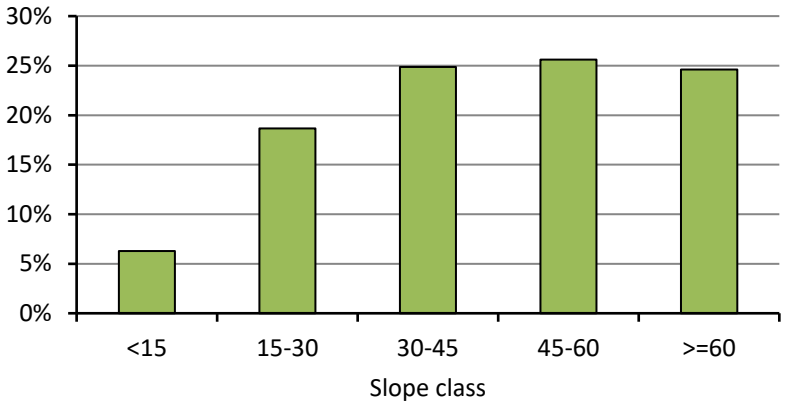
Most of the Abies alba and Picea abies is growing in high elevation levels above 1250 meters above sea level (m.a.s.l.). The Pinus sp. growing below 750 m.a.s.l. is in plantations; the most dominant species is Black pine (*Pinus nigra*). The oak species are mainly growing between 500 and 1000 m.a.s.l.

*Table: Growing stock in forest by tree species and slope class (1000 $m^3$, %)*

| Tree species | Slope class | | | | | Total |
|---|---|---|---|---|---|---|
| | <15 | 15-30 | 30-45 | 45-60 | >=60 | |
| *Quercus cerris* | 623 | 1 245 | 1 160 | 957 | 296 | 4 282 |
| *Quercus petrae* | 301 | 633 | 923 | 1 133 | 679 | 3 669 |
| Other *Quercus* sp. | 198 | 516 | 256 | 256 | 66 | 1 292 |
| *Fagus* sp. | 206 | 2 920 | 4 865 | 4 819 | 5 715 | 18 524 |
| Other broadleaves | 951 | 1 292 | 1 704 | 1 522 | 1 280 | 6 750 |
| *Abies alba* | 34 | 157 | 84 | 562 | 736 | 1 573 |
| *Picea Abies* | 117 | 350 | 297 | 664 | 412 | 1 840 |
| *Pinus* sp. | 112 | 393 | 781 | 438 | 779 | 2 502 |
| Other conifers | 1 | 50 | 2 | 23 | 2 | 77 |
| **Total** | 2 543 | 7 556 | 10 072 | 10 374 | 9 965 | **40 508** |

These figures could support the estimation of growing stock available for wood supply in Kosovo. Approximately 50% of growing stock is situated on slopes steeper than 45%. 31% of the Beech (*Fagus*) volume grows on slopes steeper than 60%. Harvesting and terrain transport when inclination is >45% may be difficult, and are normally more expensive. Slope length and distance to tractor road should also be taken into consideration when assessing accessibility.

Figure: Total growing stock in forest by slope class (%)




The average growing stock in Kosovo forest is 84 $m^3$/ha. In Europe as a whole, the average growing stock is 105 $m^3$/ha, which is less than the world's average of 130 $m^3$/ha. Some Central European countries have forests with high productivity yielding stocking levels up to 250 $m^3$/ha. In all European regions the growing stock have increased steadily during the past 20 years. The increase is due to both increases in forest area and stocking levels.

Before the 1999 conflict, the estimated growing stock in Kosovo's high forest was estimated at 17-18 million $m^3$, and the total standing volume for all forest types at approximately 30 million $m^3$. Due to difference in methodology and definitions of what constitutes a forest area, it is not straightforward to compare growing stock estimates from different periods and forest inventories. Previous assessments were based on the aggregation of data from stand-wise forest management plans, and mainly focused on State forests, with inventory results from private forests being negligible or non-existing.

## Carbon stock

Through the process of photosynthesis, the trees' green leaves and needles convert atmospheric $CO_2$ into solid carbon stored in biomass. The status and change in these carbon stocks, and dead wood, litter and soils, determines the forest's status as a sink or source of $CO_2$. Quantifying the sink/source-status provides insight into the role of Kosovo forest in compensating greenhouse gas emissions from other sectors of society, and the forest's capacity to mitigate climate change. Forest management practices will affect the growth of trees, thus influencing the carbon storage in Kosovo's forests.

*Table: Woody biomass separated on above- and below-ground components, and total corresponding carbon stocks and carbon dioxide equivalents in forest by tree species group (1000 tonnes).*

| Tree species group | Basic wood density | Above-ground biomass | | | Below-ground biomass | | Total biomass | Total carbon stock | Total $CO_2$-equivalents |
|---|---|---|---|---|---|---|---|---|---|
| | | Growing stock | Biomass expansion factor | Total | Root/ shoot ratio | Total | | | |
| | *tonnes/ m3* | *m3* | | *tonnes* | | *tonnes* | *tonnes* | *tonnes* | *tonnes* |
| Coniferous | 0,40 | 6 080 | 1,3 | 3 162 | 0,35 | 1 107 | 4 269 | 2 134 | 7 825 |
| Broadleaves | 0,58 | 40 251 | 1,4 | 32 684 | 0,35 | 11 439 | 44 123 | 22 062 | 80 892 |
| **Total** | | **46 331** | | **35 746** | | **12 546** | **48 392** | **24 196** | **88 717** |

*Explanation to the table: The biomass expansion factor adds biomass of small branches, tree tops and leaves to stem biomass. Below-ground biomass is 35% of above-ground biomass (root/shoot ratio). Dry woody biomass contains 50% carbon. The total weight of carbon dioxide molecules containing one tonne of carbon is 3.667 tonnes ($CO_2$/C-ratio = 44/12)[1].*

Over 24 million tonnes of carbon, almost 90 million tonnes $CO_2$, is stored in the woody biomass of Kosovo's forest. In 2002, emissions of $CO_2$ from lignite-based electricity generation were 10.8 million tonnes (MESP, 2006). In 2008, emissions were 6.2 million tonnes from Kosovo A and B plants together (Isufi 2010). The annual gross $CO_2$-sequestration of woody biomass is estimated at about 3 million tonnes. However, most of the annual increment of woody biomass is removed through harvesting and decomposition, so there is practically no net accumulation of carbon dioxide in Kosovo's forests.



Figure: The thermal power plant Kosovo A emits $CO_2$ ,toxic gases and dust. (photo courtesy www.xenini.com, 2004)

Each year the European forest sequesters net 870 million tonnes carbon, corresponding to 10% of Europe's annual greenhouse gas emissions in 2008 (FOREST EUROPE, UNECE and FAO 2011).

When Kosovo becomes a signatory state to the UN Framework Convention on Climate Change (UNFCCC) and associated agreements, like the Kyoto Protocol, the country must submit annual reports on greenhouse gas emissions and removals from various sectors, including land use, land use change and forestry.

[1] Penman et al 2003.

## Forest health

Both biotic agents, such as virus, bacteria, fungi, insects and grazing animals, and abiotic agents, such as wind, snow, cold, fire and landslides, are often synonymous to economic loss in managed forest ecosystems. Forest management practices can influence the way in which forests can tackle abiotic and biotic stress. Climate change can also alter the damage pattern in forests through an increase in insect outbreaks, storms and fire. At the same time, disturbances caused by biotic and abiotic stressors can pave the way for natural processes such as regeneration, selection and adaptation.

*Table: Damage to growing stock by tree species group and cause of damage and (1000 $m^3$)*

| Tree species group | Cause of damage | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | None | Insect | Disease/ fungi | Fire | Animal | Weather | Human impact | Suppres-sion | Misc. | |
| Coniferous | 5 207 | 69 | 32 | 112 | 0 | 105 | 143 | 179 | 144 | 5 992 |
| Broadleaved | 29 458 | 840 | 1 087 | 347 | 32 | 153 | 457 | 1 063 | 1 079 | 34 516 |
| **Total** | 34 665 | 909 | 1 119 | 459 | 32 | 258 | 600 | 1 242 | 1 223 | **40 508** |

13.1% of coniferous trees (784 000 $m^3$) and 14.7% (5 058 000 $m^3$) of broadleaved trees were classified with damages. In total, 14.5% of the growing stock was affected by damage. Considering the large area of uneven-aged forest, some level of suppression is expected. It is likely that a significant proportion of the damaged trees eventually will recover its vitality.

*Table: Area of damage to small trees (more than 25% of area), by forest composition and cause of damage (ha)*

| Forest composition | Cause of damage, small trees, dbh < 7 cm | | | | Total |
|---|---|---|---|---|---|
| | Disease/fungi | Fire | Animal | Human impact | |
| Coniferous | | 600 | | | 600 |
| Mixed | | | | 200 | 200 |
| Broadleaved | 400 | 6 400 | 1 200 | 3 000 | 11 000 |
| **Total** | 400 | 7 000 | 1 200 | 3 200 | **11 800** |

The observed damage to small trees reflects disturbance that has occurred fairly recently. The result represents area where more than 25% of the area of small trees has been affected. Damage by fire is the most frequently reported disturbance.

*Table: Area of significant stand-level damage, by forest composition and cause of damage (ha)*

| Forest composition | Cause of damage | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Insects | Disease/ fungi | Fire | Animal | Weather | Human impact | Suppress ion | Misc. | |
| Coniferous | 200 | 200 | 2 200 | 0 | 400 | 800 | 0 | 800 | **4 600** |
| Mixed | 600 | 400 | 0 | 0 | 400 | 200 | 0 | 200 | **1 800** |
| Broadleaved | 3 000 | 10 200 | 10 000 | 1 800 | 2 400 | 7 800 | 5 200 | 11 400 | **51 800** |
| **Total** | **3 800** | **10 800** | **12 200** | **1 800** | **3 200** | **8 800** | **5 200** | **12 400** | **58 200** |

Table # includes areas where more than 25 percent of the small trees have been affected, or where more than 25 percent of the growing stock of measurable trees has been affected. The data is a combination of  Table # and Table #. Here, fire is the single most important disturbance, affecting an area of 12 200 ha, or 2.5% of the total forest area.



Figure 5: Area severely affected by forest fire in Radusha, Istog (234 ha burned in 2007)

## Wood harvesting and forest productivity

Maintaining or enhancing the growing stock as basis for wood supply is a key criterion of sustainable forest management. In order to maintain productivity, removal of wood cannot exceed annual increment over the long term.

### Increment and fellings

All volumes of increment and wood removals are given in cubic meter over bark.

*Table: Annual increment of trees with dbh >=7 cm in forest in 2002 and 2012, by tree species (1000 $m^3$)*

| Tree species | 2002 | 2012 |
|---|---|---|
| *Quercus cerris* | 258 | 193 |
| *Querus petrea* | 182 | 158 |
| Other *Quercus* spp. | 5 | 68 |
| *Fagus* spp. | 501 | 576 |
| Other broadleaves | 174 | 329 |
| Undefined broadleaves | 228 | 0 |
| *Abies alba* | 92 | 82 |

| | | |
|---|---|---|
| *Picea abies* | 51 | 71 |
| *Pinus* spp. | 70 | 77 |
| Other conifers | 8 | 2 |
| **Total** | **1 567** | **1 556** |

Annual increment in 2012 is similar to 2002, when the increment of forest located at inaccessible areas to a large extent was classified as "undefined broadleaves"[2]. Much of this volume is now most likely classified as either beech or other broadleaved species. The results indicate that the annual increment of *Quercus* spp. has declined slightly, whereas the increment of coniferous species has increased.

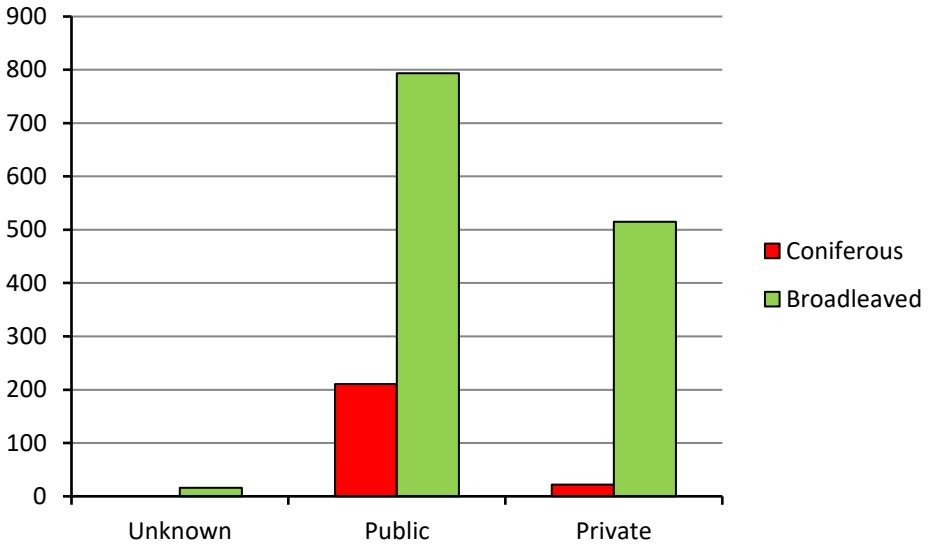



Figure 6: Annual increment in forest by ownership and tree species group (1000 $m^3$)

Most of the increment is in public forest, because most of the forest is publicly owned (62%).

*Table: Area, mean growing stock and annual increment in forest by tree species group and ownership (ha, $m^3$/ha, %)*

| Owner-ship | Tree species group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coniferous | | | Broadleaved | | | Mixed | | |
| | *area* | *vol/ha* | *increm.* | *area* | *vol/ha* | *increm.* | *area* | *vol/ha* | *increm.* |
| Public | 21 000 | 209 | 3.1 | 266 000 | 80 | 3.2 | 7 000 | 251 | 3.5 |
| Private | 2 600 | 152 | 3.8 | 177 200 | 68 | 3.7 | 600 | 342 | 3.1 |

89% of the coniferous forest area stocked by trees with dbh >7 cm is owned by the public, including most of the natural forest at higher altitudes. This explains the higher average growing stock in volume per ha in public forest. Also for broadleaved forest, average growing stock is higher in public forest than in private. The large portion of *Fagus* forest under public ownership may contribute to the higher mean stocking level. The relatively large portion of broadleaved forest actively managed

[2] In the NFI 2002 sample plots located closer than 5 km from the Serbian border were inaccessible due to security restrictions.

for short rotation coppice, may explain the higher volume increment percent in private forest compared to public forest.

*Table: Average annual felling in forest by tree species group and ownership (1000 $m^3$). Data are based on re-measured sample plots.*

| Tree species group | Ownership | | | Total |
|---|---|---|---|---|
| | Unknown | Public | Private | |
| Coniferous | 0 | 123 | 12 | **135** |
| Broadleaved | 2 | 496 | 326 | **823** |
| **Total** | **2** | **619** | **338** | **959** |

These figures are based on measurements on re-measured trees, i.e. exactly the same trees as in 2002. This enabled the fieldworkers to assess exactly which trees that had been harvested during the period 2002-2012. These re-found plots represent 60% of the total forest area in Kosovo. Assuming that the surveyed area is representative for the total forest area, 1.6 million $m^3$ have been felled annually, with 1.0 million $m^3$ felled in public forest and 560 000 $m^3$ felled in private forest.



Figure 7: Log transport from harvesting area in Radushe, Istog

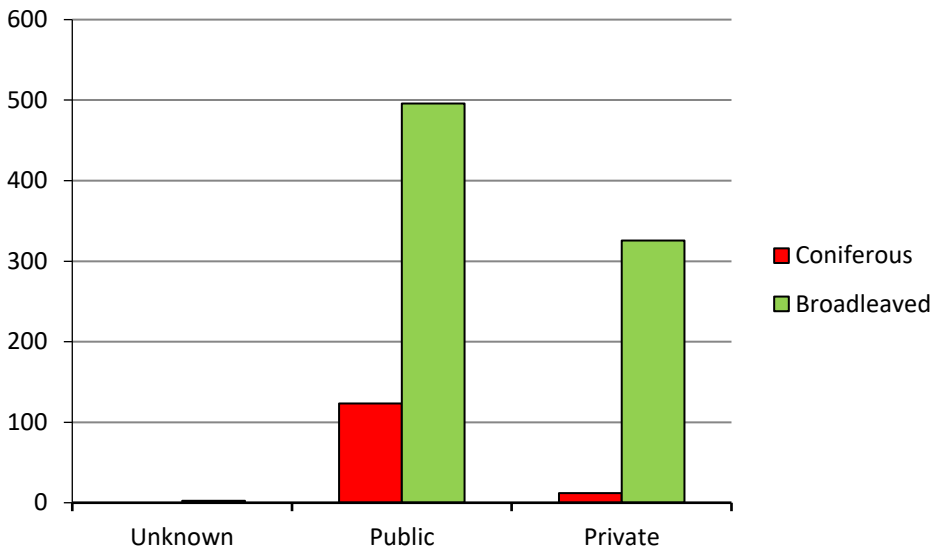



Figure 8: Average annual felling by ownership and tree species group (1000 $m^3$)

The calculation is based on 60 % of the total forest area of Kosovo.

Legislation in Kosovo state that foresters from Kosovo Forest Agency must mark trees with a special hammer before harvesting. Stumps were assessed for visible signs of tree marks.

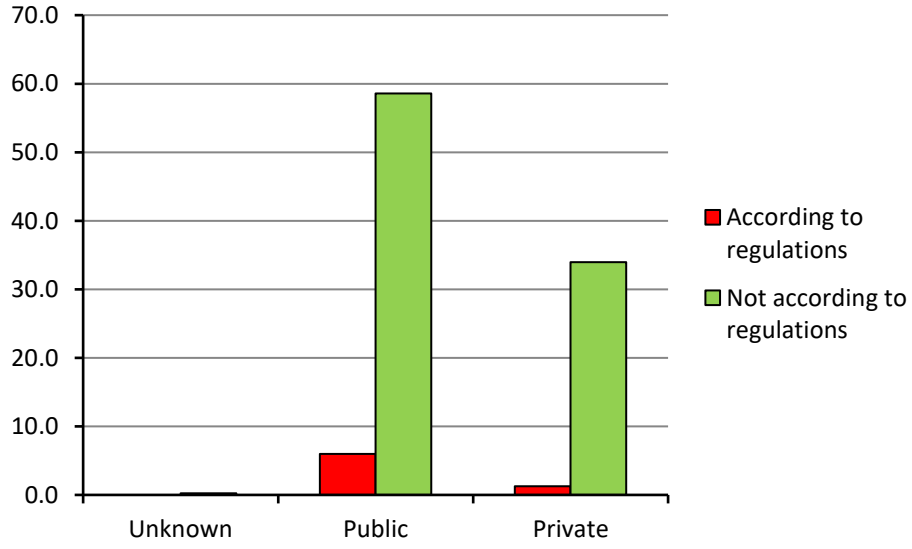



Figure 9: Felling from 2003 until 2012 by ownership and accordance with regulations (%)

Over 90% of the annual fellings are not carried out according to regulations, with approximately 59% taking place in public forest and 34% in private forest.

This pattern of irregularities is confirmed by recent management planning. For a number of management units, and during a 5-year period, the total stand area affected by irregular logging was 23 250 ha, and close to 780 000 $m^3$ of timber was harvested without marking. Wood increment adds to a total of 945 000 $m^3$. Thus, irregular harvesting constituted approximately 80% of the increment. (Norwegian Forestry Group 2013).



Figure 10: Wasteful tree harvesting: high stump, inefficient log utilization and damage to remaining trees. From Decani valley.

*Table: Gross annual increment and drain of wood by tree species group (1000 $m^3$, the whole country).*

| Tree species group | Annual increment | | | Annual drain | | | |
|---|---|---|---|---|---|---|---|
| | Trees dbh >=7cm | Small trees | **Total** | Harvest | Natural loss | Total surveyed | **Total** |
| Coniferous | 233 | 6 | 240 | 135 | 40 | 175 | 292 |
| Broadleaved | 1 325 | 396 | 1 721 | 823 | 119 | 942 | 1 570 |
| **Total** | 1 558 | 402 | 1 960 | 959 | 159 | 1 118 | 1 862 |

Annual increment of small trees is based on a number of assumptions, and are more uncertain than the estimates for the measured trees (dbh>=7 cm). Annual drain was assessed based on 60% of the total forest area, i.e. on the sample plots that were re-measured in 2012, assuming the surveyed area was representative for the total forest area.

*Table: Net annual increment of trees with dbh >= 7cm by tree species group and ownership (1000 $m^3$)*

| Tree species group | Ownership | | | Total |
|---|---|---|---|---|
| | Unknown | Public | Private | |
| Coniferous | 0 | 146 | 4 | 150 |
| Broadleaved | 14 | 733 | 502 | 1 249 |
| **Total** | 14 | 879 | 506 | **1 399** |

The net annual increment is annual increment minus natural losses of trees every year during the 10-year period (2003-2012).

Annual increment of trees with dbh>= 7 cm almost balances the annual harvesting (1.56 million $m^3$ vs. 1.60 million $m^3$). At national level it seems that annual removals and natural losses of wood are balanced by gross annual increment. Based on the share of degraded high forest and results from recent forest management planning, in certain areas over-harvesting have taken place.



Figure: Intact high forest (left) and forest near-by with uncontrolled harvesting (right) in Hajle, Peje

In Europe as a whole, harvesting has declined for the last 20 years, most markedly in Northern Europe and in the Russian Federation. Overall 2/3 of the annual increment of wood is harvested each year in Europe.

Previous estimates of annual felling rates in Kosovo vary considerably and reports are scarce and uncertain, in particular regarding felling of wood for heating. Kosovo has Europe's highest annual felling rate (from forests available for wood supply), i.e. felling as a fraction of net annual increment (FOREST EUROPE, UNECE AND FAO 2011). In the few South-East European countries reporting their forest inventory statistics, both net annual increment and felling rates have increased in the period 1992-2012 Among the former Yugoslavian countries, Slovenia has a felling rate of 37%, which is the lowest in Europe. South East Europe as a whole has a felling rate of around 50%.

## Annual allowable cut

It is of strategic importance for a country to know the quantity of wood that over the long-term can be harvested every year. One of the main criteria for sustainable forest management is the harvesting level. An annual harvesting level that does not exceed the growth potential of the forest, indicates sound forest management. This harvesting level is called "annual allowable cut " (AAC). Recommended sustainable cut every year is not necessarily the same. Decision-makers could also

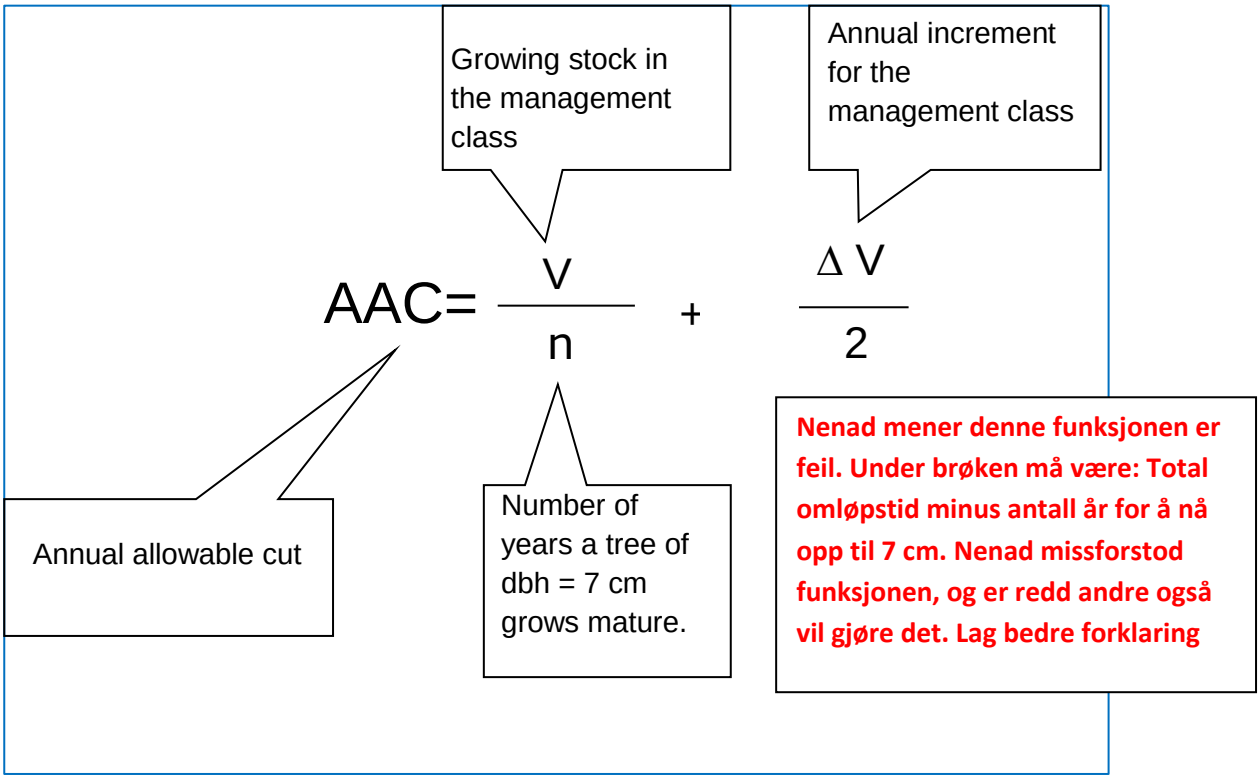
consider other factors, such as quality of information and people's needs, when arriving at the actual annual harvesting level.

Modeling sustainable harvesting levels can be more or less sophisticated, depending on the quality of available data and assumptions. In the new forest management plans, this is done management class by management class, using one of the three approaches:

- Increment
- Calculated harvesting potential from the amortization formula
- Test-marked volumes

The approach that best suits the condition of each forest management class is chosen. The same approach for modeling AAC is also used for the country-wide NFI data, with some adjustments.

The total increment for trees bigger or equal to 7 cm dbh is as described 1 550 000 $m^3$. The "amortization formula" is used as follows:




Figur 11: The amortization formula for calculating annual allowable cut (AAC)

Average rotation period for the trees in high forest is 80 - 100 years. To reach the dbh of 7 cm the trees will use 15 - 17 years in average. Coppice forest of oak and other broadleaved species, except for beech, are expected to have a rotation period of 50 to 60 years.

Based on experience, for degraded forest the model assumes an AAC close to 50% of the volume calculated with the formula above. The gross sustainable harvesting potential by using this method is 1 446 000 $m^3$ pr. year. Two other models for estimating AAC at national level have been tested and yield similar results.

The model is a simplification and yield rough estimates with considerable uncertainty. Yet, it is the most feasible to apply for Kosovo at current.

*Table: Estimation of annual allowable cut (AAC, 1000 m³)* [3]

| Model | Forest type | dbh limit (cm) | Years | Volume > dbh limit | Increment | AAC |
|---|---|---|---|---|---|---|
| The FMP method: | High | 7 | 80 -100 | 16 091 | 390 | 631 |
| | Coppice | 7 | 50 - 60 | 13 589 | 440 | 815 |
| | **Total** | | | | | **1 446** |

According to the model, an annual total harvest of 1.45 million m³ is sustainable, with approximately 630 000 m³ in high forest and 815 000 m³ in coppice forest. Today, the current annual harvest is estimated at 1.6 million m³, which is above the recommended long-term harvesting levels. Felling rate above 100% may be sustainable over a period of time, for example when responding to a high demand for timber or when carried out under a highly controlled management regime (FOREST EUROPE, UNECE and FAO 2011).



Figure: Transport of firewood in Nerodime Jezerc, Ferizaj

It should be noted that this analysis is based on the entire forest area, and gives the gross figures. Even though harvesting is currently executed throughout the forested terrain, some areas are considered inaccessible due to steepness and remoteness. As the general price level in Kosovo increases, more forest areas are likely to become “economically unavailable for wood supply”. Moreover, the national parks, which cover a significant part of the forest area in Kosovo, are included in the figures. There will be harvesting restrictions within different zones of the parks. These areas are not known at the moment. Finally, at each harvesting plot some trees will normally be left for either environmental or purely economic reasons. How much the gross AAC should be reduced in

[3] Figures refer to the gross total volume including bark, large branches (dbh >7 cm), tops and other losses. The merchantable volume will thus be substantially lower.

order to reach a realistic potential utilizable harvesting volume, is difficult to state with certainty. But it is likely to be in the range of at least 10 – 20%, before any reductions for the growing stock within the national parks.

Net maximum long-term harvesting level for Kosovo is at the level of 1.2 million $m^3$. This estimate should be further reduced due to areas unavailable for wood supply, including National Parks.

The 2002-2003 NFI found an AAC of 720,000 $m^3$ in high forest and 215,000 $m^3$ in coppice forest. The large difference between the old estimate and the current one is mainly due to changed assumptions, including reclassification of high forest areas to coppice forest.

## Forest management

Since 2006 development of new cost-efficient forest management plans (FMPs) has been a priority for the Kosovo government, and, with the aid of the Norwegian government, a total of 39 new management plans have been prepared/developed. The forest management planning method for Kosovo includes classification of forest stands according to management classes. During the NFI this classification was also applied on the sample plots, providing overall statistics for Kosovo.

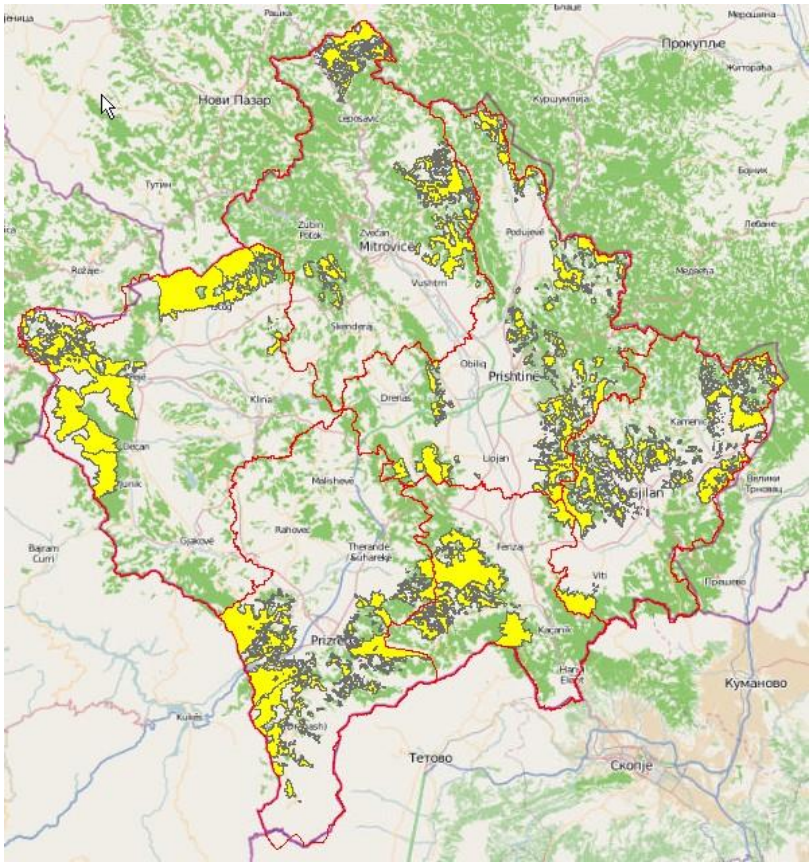



Figure 12: The yellow area shows forest areas covered by the new forest management plans in Kosovo.

During 2013, 12 new plans have been prepared. The majority are financed by the Government of Kosovo, which for the last few years has allocated considerable funds for this purpose. Almost half of the management units will have new plans by the end of 2013.

Most of Europe's forest is covered by some kind of forest management plan. In South-East Europe there is a long tradition of regulating forest management through management plans, both at the management unit, regional and central levels. In Serbia, 82% of the forest area is under FMP or an equivalent, Albania reports that all of their forest is covered by management plans, whereas Croatia reported 22% under equivalents and 78% under FMPs (FOREST EUROPE, UNECE AND FAO 2011).

*Table: Forest area, growing stock and fellings from 2003 – 2012, by management class (ha, 1000 $m^3$)*

| **Management class** | **Area** | **Growing stock** | **Average growing stock** ($m^3$/ha) | **Felling** (9 yrs) |
|---|---|---|---|---|
| Uneven-aged high forest of beech | 37 600 | 12 708 | 338,0 | 1 361 |
| Uneven-aged, mixed high forest of beech, fir and spruce, and other broadleaves | 5 800 | 1 661 | 286,4 | 355 |
| Uneven-aged high forest of pine | 3 200 | 1 043 | 325,9 | 24 |
| Uneven-aged high forest of oak | 1 600 | 306 | 191,3 | 22 |
| Uneven-aged high forest of fir | 1 800 | 488 | 271,1 | 140 |
| Uneven-aged high forest of spruce | 6 000 | 1 040 | 173,3 | 236 |
| Uneven-aged mixed high forest of conifers | 3 800 | 1 214 | 319,5 | 131 |
| Uneven-aged high forest of birch | 2 400 | 506 | 210,8 | 0 |
| Uneven-aged high forest of other broadleaves | 3 600 | 753 | 209,2 | 32 |
| Degraded high forest of beech due to fire | 2 200 | 362 | 164,5 | 94 |
| Degraded high forest of beech due to illegal harvesting | 2 400 | 183 | 76,3 | 206 |
| Degraded high forest of beech, fir, spruce and other broadleaves due to illegal harvesting | 600 | 79 | 131,7 | 145 |
| Degraded pine forest due to fire | 2 200 | 92 | 41,8 | 117 |
| Degraded pine forest due to illegal harvesting | 200 | 6 | 30,0 | 0 |
| Degraded fir forest due to fire | 400 | 3 | 7,5 | 0 |
| Degraded fir forest due to other reasons | 200 | 6 | 30,0 | 119 |
| Degraded fir forest due to illegal harvesting | 400 | 107 | 267,5 | 101 |
| Degraded high forest of spruce due to forest fire | 600 | 42 | 70,0 | 26 |
| Degraded high forest of spruce due to illegal harvesting | 1 200 | 100 | 83,3 | 0 |
| Even-aged pine forest | 3 200 | 490 | 153,1 | 140 |
| Even-aged fir forest | 200 | 0 | 0 | 1 |
| Even-aged spruce forest | 400 | 57 | 142,5 | 0 |
| Beech-dominated coppice forest | 37 000 | 4 556 | 123,1 | 893 |
| Mixed beech and other broadleaved coppice forest | 15 800 | 1 066 | 67,5 | 370 |
| Oak-dominated coppice forest | 209 200 | 8 305 | 39,7 | 2 002 |
| Degraded coppice forests due to forest fire | 5 200 | 224 | 43,1 | 27 |
| Degraded coppice forests due to other reasons | 1 000 | 43 | 43,0 | 0 |
| Degraded coppice forest due to improper management | 18 600 | 213 | 11,5 | 801 |
| Hornbeam-dominated coppice forest | 23 600 | 897 | 38,0 | 199 |
| Coppice forest of other broadleaves | 79 600 | 3 578 | 44,9 | 1 090 |
| Bushland suited for conversion to pine forest | 1 200 | 0 | 0 | 0 |
| Forests of pinus mugo | 1 800 | 30 | 16,7 | 0 |
| Bushland not suited for conversion | 5 800 | 349 | 60,2 | 1 |

| | | | | |
|---|---|---|---|---|
| Unclassified area | 2 200 | 0 | 0 | 0 |
| **Total** | **481 000** | **40 508** | **84** | **8 633** |

*Table: Forest area sorted by treatment class and stand origin (ha)*

| **Treatment class** | **Stand origin** | | | | **Total** |
|---|---|---|---|---|---|
| | *Natural seeding* | *Planting/artificial seeding* | *Coppice* | *Coppice with standards* | |
| No treatment | 45 000 | 2 400 | 311 200 | 3 000 | 361 600 |
| Regeneration without site preparation | 1 400 | 0 | 2 600 | 0 | 4 000 |
| Regeneration with site preparation | 200 | 0 | 400 | 0 | 600 |
| Conversion | 0 | 0 | 2 000 | 0 | 2 000 |
| Cleaning-thinning | 2 200 | 0 | 46 200 | 1 000 | 49 400 |
| Thinning | 11 800 | 400 | 29 800 | 2 600 | 44 600 |
| Clearcut | 0 | 0 | 400 | 0 | 400 |
| Selection | 9 600 | 0 | 3 600 | 600 | 13 800 |
| Salvage/sanitary | 2 800 | 0 | 1 600 | 0 | 4 400 |
| Repair planting | 0 | 0 | 0 | 200 | 200 |
| **Total** | 73 000 | 2 800 | 397 800 | 7 400 | 481 000 |
| **Total with treatment recommendation** | **28 000** | **400** | **86 600** | **4 400** | **119 400** |

The fieldworkers have assessed 119 400 hectare, i.e. one-quarter of Kosovo's forest area, in need of some kind of silviculture or harvesting operation. In addition to the NFI assessment, at operational level through forest management planning treatment strategies are drafted for each management class.



Figure: Oak (*quercus*)-dominated coppice forest (left) and well-tended young coppice (right). Firewood is extracted through the tending operation. Remaining trees will have more space to grow into higher quality logs.

*Table: Growing stock by tree quality and tree species (1000 $m^3$)*

| Tree species | Quality class | | | | Total |
|---|---|---|---|---|---|
| | High | High - average | Average - low | Low | |
| *Quercus cerris* | 110 | 439 | 1 095 | 2 637 | 4 281 |
| *Querus petrea* | 99 | 251 | 727 | 2 592 | 3 669 |
| *Other quercus sp.* | 4 | 45 | 381 | 861 | 1 291 |
| *Fagus sp.* | 644 | 2 781 | 4 959 | 10 139 | 18 523 |
| Other broadleaves | 77 | 258 | 1 053 | 5 362 | 6 750 |
| *Sub-total broadleaves* | *934* | *3 774* | *8 215* | *21 591* | *34 514* |
| *Abies alba* | 690 | 542 | 302 | 39 | 1 573 |
| *Picea abies* | 557 | 890 | 310 | 84 | 1 841 |
| *Pinus sp.* | 526 | 953 | 826 | 197 | 2 502 |
| Other conifers | 13 | 57 | 1 | 6 | 77 |
| *Sub-total coniferous* | *1 786* | *2 442* | *1 439* | *326* | *5 993* |
| **Total** | **2 720** | **6 216** | **9 654** | **21 917** | **40 508** |

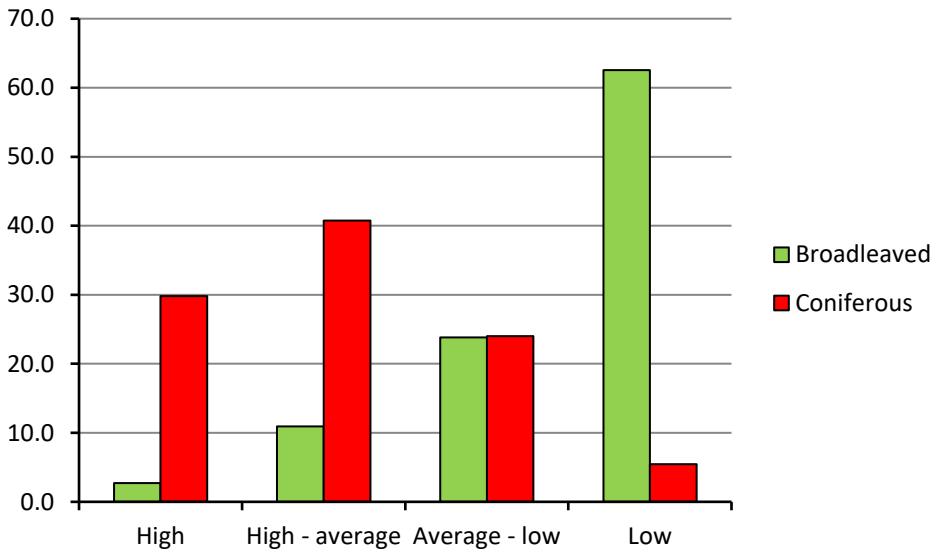



Figure 13: Growing stock of tree species groups by tree quality class (%)

While most of the growing stock of broadleaved species is in the poorer assortments, the largest share of growing stock of the conifer species is in the higher quality classes.

## Biodiversity

### Tree species composition

Forest biodiversity is measured by the number of species occurring in forest land and other wooded land. Species composition is affected by ecological species characteristics such as growth and reproduction, site conditions, disturbance factors and forest management. In general, mixed forest, consisting of two or more species, are often richer in biodiversity than single species forests.

*Table: Forest area by tree species abundance category (ha)*

| Tree species abundance class | | | | Total |
|---|---|---|---|---|
| *1* | *2-3* | *4-5* | *6+* | |
| 122 000 | 226 800 | 100 400 | 31 800 | 481 000 |

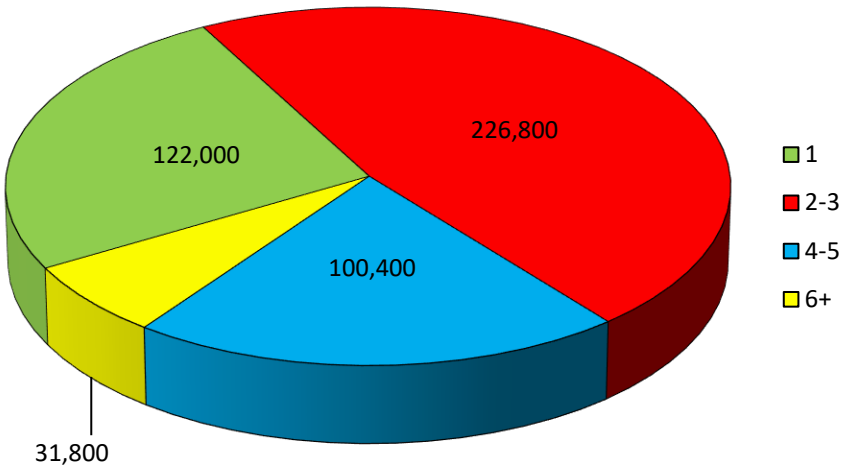



Figure 14: Forest area by species abundance category (ha)

The figure shows that most of the forest area in Kosovo consists of mixed species stands; 21% of the forest area consists of 4 – 5 different tree species.

## Regeneration

Natural regeneration conserves genotype diversity and maintains both the natural species composition, stand structure and stand dynamics. Regeneration is crucial to the long term maintenance of forest land. A sustainable forest management can be identified by the status and change in regeneration types over time.

*Table: Forest area by forest composition and stand origin (ha)*

| Forest composition | Stand origin | | | | Total |
|---|---|---|---|---|---|
| | Natural seeding | Planting or artificial seeding | Coppice | Coppice with standards | |
| Coniferous | 21 400 | 2 400 | 0 | 0 | 23 800 |
| Mixed | 6 200 | 0 | 1 600 | 0 | 7 800 |
| Broadleaved | 45 400 | 400 | 396 200 | 7 400 | 449 400 |
| **Total** | 73 000 | 2 800 | 397 800 | 7 400 | **481 000** |

*Table: Forest area by stand origin and stand structure (ha and %)*

| Stand origin | Stand structure | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Even-aged | | Two-storied | | Uneven-aged | | |
| | *ha* | *%* | *Ha* | *%* | *ha* | *%* | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Natural seeding | 22 400 | 5 | 26 000 | 5 | 24 600 | 5 | 73 000 |
| Planting or artificial seeding | 2 200 | 0 | 600 | 0 | 0 | 0 | 2 800 |
| Coppice | 263 400 | 55 | 104 800 | 22 | 29 600 | 6 | 397 800 |
| Coppice with standards | 2 600 | 1 | 1 600 | 0 | 3 200 | 1 | 7 400 |
| **Total** | 290 600 | 60 | 133 000 | 28 | 57 400 | 12 | **481 000** |

In Kosovo, 0.5% percent of the forest is regenerated by planting or artificial seeding. Approximately 85% of the forest area is regenerated through coppice sprouting. In South-East Europe as a whole, 80% of total forest area is regenerated naturally. In 2010 Albania reported that close to 90% of their forested area was regenerated naturally and Serbia reports around 93%. South-East Europe stands out as a region with a relatively high share of forest area increase through natural expansion (FOREST EUROPE, UNECE AND FAO 2011).

## Naturalness

Large, continuous tracts of undisturbed forests, i.e. forests that are undisturbed by man usually has a higher conservation value than managed forest. In such undisturbed forests natural dynamics are allowed to take place, resulting in relatively large shares of dead wood, natural species composition and variation in age structure. Most of Europe's forest area is classified as semi-natural. The forest may be marked by human intervention through forest management and other traditional land uses, and by physical constructions such as artificial water ways and other infrastructures, but retain some the characteristics of natural forest ecosystems.

*Table: Forest area in Kosovo by naturalness (ha, %)*

| Naturalness | Area | |
|---|---|---|
| | *ha* | *%* |
| Forest undisturbed by man | 4 000 | 0,83 |
| Semi-natural forest | 475 400 | 98,84 |
| Plantation | 1 600 | 0,33 |
| **Total** | 481 000 | 100 |

In Kosovo less than 1% of forest area is characterized as undisturbed by man and only 0.3 percent of the forest area is classified as plantation.

In South-East Europe, 6% of the forest is reported to be undisturbed, whereas 17% is forest plantations. This is the highest share of plantations among the European regions. Albania reported that close to 11% of their total area undisturbed by man, whereas Slovenia reported 8% . Albania reported that 14% of their forest area was plantations and Croatia 5%.

## Introduced tree species

Introduced tree species are species that occurs outside its natural vegetation zone. Other terms that are used are "non-indigenous species", "exotic species", or "alien species". Introduced tree species have been introduced for various reasons, such as for forestry, erosion protection, or gardening and botanical gardens and arboreta. In some countries introduced species play a significant role in increasing the forest area through afforestation.



Figure 15: Field personnel in black locust forest

The most common introduced tree species in Kosovo is Black locust (*Robinia pseudoacacia*) which is native to the southeastern United States. It has been present in Europe for several hundred years, and was introduced mainly to prevent soil erosion and in order to stabilize the soils. In some locations, the tree has spread and is considered a challenge to the natural forest.

The black locust covers 2 400 hectares, and including larch (*Larix spp.*) and Douglas fir (*Pseudotsuga menziesii*), the total area dominated by introduced tree species is estimated at 3 200 hectares, only 0.6% of the total forest area.

As a percentage of total forest area, Black locust covers a smaller fraction than what is reported for Slovenia. The trend in South East Europe between 2000 and 2010 is that the area covered by introduced tree species is increasing.

## Dead wood

Dead wood often contains various habitats each associated with a certain group of species. Insects, fungi, birds and small mammals depend on standing and lying dead biomass in the forest for their survival. In order to conserve biodiversity, leaving dead biomass in the forest has become an important management practice, and it plays an important role in forest management certification.

The quantity of dead wood depends on tree species, natural disturbance, stand successional stage, climate and soils. Branches and other tree parts left in the forest after harvesting constitute an important part of this, but some species require standing and lying trees of a certain size in order to survive. In general, lying dead trees host more biodiversity that standing dead trees.

*Table: Total volume of dead wood and quantity of deadwood per hectare*

| **Status** | **Volume ($m^3$)** | | | **Volume by forest composition ($m^3$/ha)** | | | |
|---|---|---|---|---|---|---|---|
| | *Salvageable* | *Not salvageable* | *Total* | *Coniferous* | *Mixed* | *Broadleaved* | *Total* |
| Lying | 226 000 | 399 000 | 625 000 | 10,9 | 0,96 | 0,79 | 1,30 |
| Standing | 556 000 | 555 000 | 1 111 000 | 20,3 | 5,55 | 1,3 | 2,31 |
| **Total** | 782 000 | 954 000 | 1 736 000 | 31,2 | 6,51 | 2,09 | 3,61 |

Volumes of dead wood are not included in the growing stock figures.

Salvageable volume may still be utilized, whereas non-salvageable volume is heavily decomposed and not useful for any purpose. Forests that are dominated by coniferous trees represent a much smaller area compared to area dominated by broadleaves, but contribute with a much higher average growing stock per area unit.

The extensive use of firewood by Kosovo's rural population may partly explain the low volume of dead wood registered by the NFI. It could also be that the assessment of dead wood has underestimated the quantity.

In Europe, country level estimates of dead wood vary considerably. South-East Europe has the highest reported regional mean of dead wood, at 15 $m^3$/ha. Croatia reported 14% and Slovenia

19% dead wood; lying dead wood constituted the largest portion.



Figure 16: Decaying coniferous wood due to wind and snow damages in Koshuten, Peje

## Protected forests

In Kosovo there are two forest areas that have been designated by the government as national parks: Sharri in southern Kosovo and Bjeshket e Nemuna in the western part of Kosovo. Both national parks are located in high elevation forested areas.

*Table: Forest area and growing stock in national parks by forest composition*

| National park | Resource | Forest composition | | | Total |
|---|---|---|---|---|---|
| | | *coniferous* | *mixed* | *broadleaved* | |
| Sharri | Area (ha) | 2 000 | 600 | 15 000 | 17 600 |
| | Growing stock ($m^3$) | 410 000 | 171 000 | 5 335 000 | 5 916 000 |
| Bjeshket e Nemuna | Area (ha) | 17 600 | 5 400 | 19 000 | 42 000 |
| | Growing stock ($m^3$) | 3 910 000 | 1 614 000 | 2 860 000 | 8 384 000 |
| **Total** | Area (ha) | 19 600 | 6000 | 34 000 | 59 600 |
| | Growing stock ($m^3$) | 4 320 000 | 1 785 000 | 8 195 000 | 14 300 000 |
| **Share of total for Kosovo** | Area (%) | 82 | 77 | 8 | 12 |
| | Growing stock (%) | 90 | 91 | 24 | 36 |

90% of total growing stock in coniferous forest and 91% in mixed coniferous and broadleaved forest in Kosovo, are located within the park borders. It is obvious that in the major parts of the parks forest management for wood production will still be possible. Only the Sharri national park has so far been delineated and classified into zones according to management objectives.

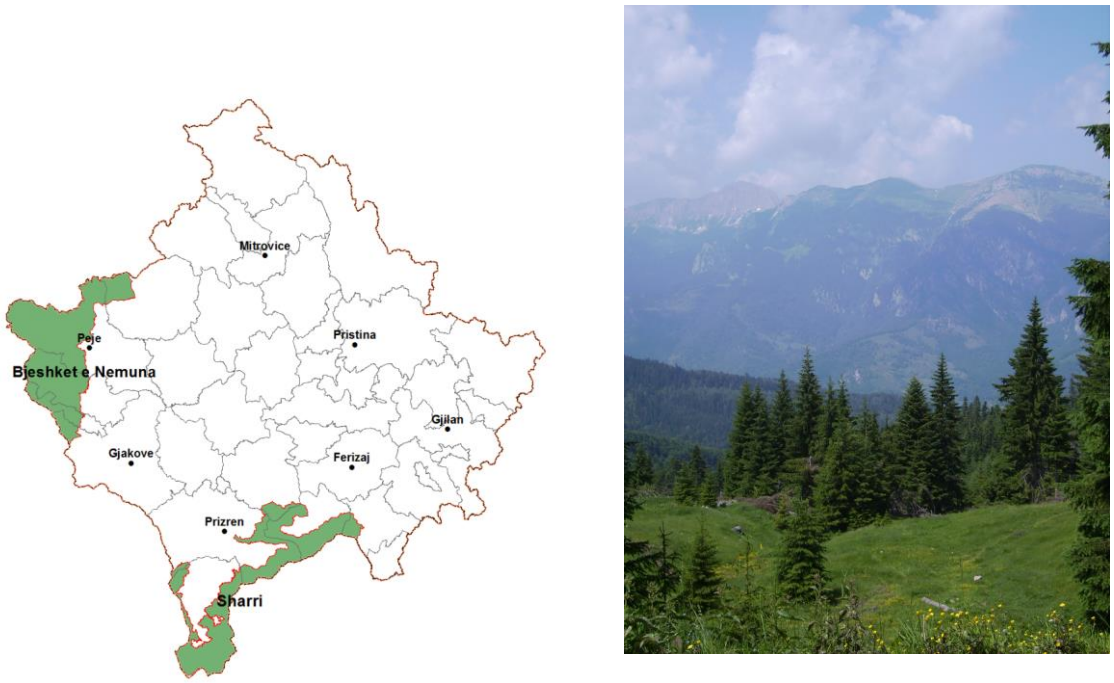



Figure 17: Location of national parks in Kosovo (left) and forested landscape in Decani (right)

# Sources of information


Drinić, Matić, Pavlič, Prolić, Stojanović, Vukmirović and Koprivica 1990. Tablice taksacionih elemenata visokih i izdanačkih šuma u Bosni I Hercegovini.

FOREST EUROPE, UNECE and FAO 2011: State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe.

Isufi, S. 2010. Emission Controls at Kosova's Thermal Power Plants - Current and Future Capabilities. Submitted as a Capstone Project in partial fulfillment of a Master of Science Degree in Professional Studies at the RIT Center for Multidisciplinary Studies. American University in Kosovo.

Ministry of Agriculture, Forestry and Rural Development 2010. Policy and strategy paper on forestry sector development 2010 – 2020. Republic of Kosovo, Pristina, 2010.

Ministry of Agriculture and Rural Development of Montenegro 2011. Results of the National Forest Inventory of Montenegro. LUX-DEVELOPMENT S.A., Luxemburg (Services contract No.: YUG/012 08 090. Subject: Advisory Team to the National Forest Inventory in Montenegro. Contractor: GeoFIS, Germany/Podgorica, 2011.

Ministry of Environment and Spatial Planning, 2006. Air pollution from lignite- based electricity generation in Kosovo. United Nations / Austria / European Space Agency - Symposium on Space Applications for Sustainable Development to Support the Plan of Implementation of the World Summit on Sustainable Development. Nezakete Hakaj. Graz, 12 -15 September 2006

Norwegian Forestry Group 2013. Newsletter March Issue. Project Support to Forest Management Planning with GIS.

Penman, J. et al. (eds.) 2003. Good Practice Guidance for Land Use, Land Use Change and Forestry. Published by the Institute for Global Environmental Strategies for the IPCC. Annex 3.A.1. Biomass Default Tables for Section 3.2 Forest Land.

SNV 2012. Study and Analysis of Innovative Financing for Sustainable Forest Management in the Southwest Balkan Inception Phase Report Part III Kosovo Wood Biomass Case Albania & Kosovo (March, April 2012). World Bank – PROFOR project contract.

The Carbon Trust 2001. Conversion factors – energy and carbon conversion, 2011. Update based on data published by Department for Environment, Food & Rural Affairs (Defra). Factsheet. UK October 2011.

Tomter, Stein M. 2003. Inventory Document. FAO Kosovo Forest Inventory Project (OSRO/KOS/105/NOR). FAO/Norwegian Forestry Group, December 2003.

# Appendices

## Appendix 1: Land use classes and definitions

**Land use**

| Land use class | Code | Definition |
|---|---|---|
| Forest | 01 | Wooded land meeting the definition of "forest". |
| Other wooded land | 10 | Wooded land not meeting the definition of "forest". |
| Cropland | 30 | Cultivated land excluding meadows and pastures. |
| Grassland | 31 | Rangelands and pasture land that are not considered cropland. Any woody vegetation must fall below the threshold values of Forest. |
| Settlements | 40 | Cities, villages, infrastructure etc. Include public roads, but not forest roads. |
| Water | 50 | Lakes, major rivers, reservoirs. |
| Other wetlands | 51 | Land that is covered and saturated by water for all or part of the year (e.g. peatland) and that does not fall into the forest, other wooded land, cropland, grassland, water or settlements categories. |
| Other land | 20 | Un-managed land areas that do not fit into any of the other categories; unproductive land, bare soil, rock |

***Forest***

Land with tree crown cover of more than 10 percent and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity in situ. May consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground: or of open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10 percent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 percent or tree height of 5 m are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest.

Includes: Forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, cleared tracts, firebreaks and other small open areas within the forest; forest in national parks, nature reserves and other protected areas such as those of special environmental, scientific,

Lightly built roads (skidding roads) like this should be considered an integral part of the forest even if the width is more than 5 m and the crown cover percentage less than 10.



historical, cultural or spiritual interest; windbreaks and shelterbelts of trees with an area of more than 0.5 ha and a width of more than 20 m.
Excludes: Land predominantly used for agricultural practices.

Note that a forest road (predominantly used for forestry purposes) constituting an integral part of the forest should be considered "forest", while a public road through a forest should be considered "settlements".

***Other wooded land***
Land either with a tree crown cover of 5-10 percent of trees able to reach a height of 5 m at maturity in situ; or a crown cover of more than 10 percent of trees not able to reach a height of 5 m at maturity in situ (e.g. dwarf or stunted trees) and shrub or bush cover.
Excludes: Areas having the tree, shrub or bush cover specified above but of less than 0.5 ha and width of 20 m, which are classed under "other land"; Land predominantly used for agricultural practices.

Note that the minimum size of continuous forest and/or other wooded land should be 0.5 ha (a square of 71x71 m, or corresponding). Areas having some tree cover, but, at the same time do not meet the requirements for forest or other wooded land, should be assigned to one of the other categories.

***Cropland***
Includes arable and tillable land, and agroforestry systems where the vegetation structure falls below the thresholds used for the Forest Land category, and is not expected to exceed those thresholds at a later time. Cropland includes all annual and perennial crops as well as temporary fallow land (i.e., land set at rest for one or several years before being cultivated again). Annual crops include cereals, oils seeds, vegetables, root crops and forages. Perennial crops include trees and shrubs, in combination with herbaceous crops (e.g., agroforestry) or as orchards and vineyards, except where these lands meet the criteria for categorisation as Forest Land. Arable land which is normally used for cultivation of annual crops, but which is temporarily used for forage crops or grazing as part of an annual crop-pasture rotation (mixed system) is included under cropland.

For other land-use types than forest and other wooded land (e.g. patches of grassland or agricultural land), the minimum size to be considered and assessed should be 1257 $m^2$ (corresponding to the circle with radius 20 m). The boundary between settlements and other land-use classes is assumed to be located 5 m from the wall/foundation of a building, if not any other obvious delimitation (like fence) is present. Roads and water (rivers, streams, ponds) having a width of less than 5 m should not be classified as a separate land-use category, but as a part of the surrounding area.

**Naturalness**

| Class | Code | Definition |
|---|---|---|
| Forest undisturbed by man (primary forest, virgin forest) | 1 | Areas where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed. This includes areas where collection of non-wood forest products occurs, provided that human impact is small. Individual trees may in some cases have been removed. |
| Semi-natural forest (normal situation) | 2 | Areas of naturally regenerated species where there are clearly visible indications of human activities.<br>This includes, but is not limited to selectively logged-over areas, areas naturally regenerating following agricultural land use, areas recovering from human-induced fires etc. This type is the most common form of naturalness for most forest types in Kosovo. |
| Plantation<br>(Pinus nigra etc.) | 3 | Areas of introduced tree species and in some cases native species, established through planting or seeding mainly for the production of wood or non-wood goods.<br>This includes all stands of introduced species established for production of wood or non-wood goods, and may include areas of native species characterized by few species, straight tree lines and/or even-aged stands. |

For the assessment, the minimum size of the area of a particular form of naturalness is 0,5 ha.

***Forest undisturbed by man:*** In addition to no clearly visible indications of human activities, the area should not have been affected by surrounding installations, like roads, buildings, ditches etc. In no case such installations should occur closer than 25 m from the plot centre. Other indicators of forest undisturbed by man are concentrations of dead wood at different stages of decay, trees of old age and uneven-aged stand structure. However, all of these indicators do not need to exist simultaneously.

| Code | Unevenaged high forest |
|---|---|
| 1100 | Beech forests (and other broadleaves in area of beech forests)<br>*More than 80 % of the tree volume in the stand should be beech.* |
| 1200 | Mixed forest of beech, fir (and spruce), and other broadleaves in area of this forests;<br>*No separate specie or gruop of species should add up to more than 80 % of the tree volume.* |
| 1300 | Pine forests;<br>*More than 80 % of the tree volume should be pine.* |
| 1400 | Oak forests;<br>*More than 80 % of the tree volume should be oak.* |
| 1500 | Fir forests<br>*More than 80 % of the tree volume should be fir.* |
| 1600 | Spruce forests<br>*More than 80 % of the tree volume should be spruce.* |
| 1700 | Mixed forest of conifers<br>*More than 80 % of the tree volume should be pine, fir or spruce.* |
| 1800 | Birch forest<br>*More than 80 % of the tree volume should be birch.* |
| 1900 | Forests of other broadleaves<br>*More `han 80 % of the tree volume should be broadleaves, and dominated by other species than beech, oak or birch.* |

## Management classes

| | **Degraded high forest**<br>*More than 50 % of the trees are dead, damaged or missing or of in optimal species due to mismanagement or some other specific reason, in a way that makes it impossible for the stand by itself to recover to a normal situation of high forest.* |
|---|---|
| 2100 | Degraded high forest of beach |
| 2200 | Degraded high mixed forest of beech fir and spruce and other broadleaves. |
| 2300 | Degraded pine forest. |
| 2500 | Degraded forest of fir |
| 2600 | Degraded spruce forest |
| 2700 | Degraded mixed forests of fir and spruce. |
| 2900 | Degraded forest of other broadleaves |

| | **Even aged high forest.**<br>*At least 80 % of the tree volume in the stand is even aged, in the sense that the age of each tree is not more than 20 % higher or lower than the average age of these trees.* |
|---|---|
| 3300 | Even aged pine forest |
| 3500 | Even aged fir forest |
| 3600 | Even aged spruce forest |

| | **Coppice forest.**<br>*Forest mainly composed of stool-shoots or root suckers with or without scattered bigger trees.* |
|---|---|
| 4100 | Beech dominated coppice forest |
| 4200 | Mixed beech and other broadleaves coppice forest |
| 4400 | Oak dominated coppice forest |
| 4800 | Hornbeam dominated coppice forest. |

| | |
|---|---|
| 4900 | Coppice forest from other broadleaves |
| | **Bush-land.** |
| 5100 | Bush land suited for converting to beech forest |
| 5200 | Bush land suited for converting to mixed forest of beech, fir and other conifers. |
| 5300 | Bush land suited for converting to pine forest |
| 5330 | Forest of pinus mugo |
| 5900 | Bush land not suited for conversion. |

| | |
|---|---|
| | **Non productive area** |
| 6100 | Forest roads |
| 6110 | Areas for wood storage |
| 6200 | Agricultural areas in use. |
| 6210 | Meadows and pastures |
| 6300 | Agricultural areas not in use, suitable for afforestation. |
| 6410 | Water |
| 6420 | Bogs |
| 6430 | Unforested bare rocks |
| 6440 | Low productive forested areas with scattered trees. |
| 6450 | Area above tree line. |
| 6460 | Erosion areas |
| 6999 | Other open areas |

## Stand origin

| Stand origin | Code | Definition |
|---|---|---|
| No existing stand | 0 | No trees with diameter more than 7 cm |
| Natural seeding | 1 | Naturally regenerated high forest (more than 50%) |
| Planting or artificial seeding | 2 | Artificially regenerated high forest (more than 50%) |
| Coppice | 4 | Low forest composed of stool-shoots (more than 50%) |
| Coppice with standards (middle forest) | 5 | As previous class, but with scattered bigger trees |

High forest:
Forest normally composed of trees of seedling origin, but may also include trees from vegetative reproduction, e.g. poplars. Includes stands in process of transformation into high forest.

Coppice and coppice with standards (low forest):
Forest composed of stool-shoots or root suckers with or without scattered bigger trees (standards), which may be of seedling or coppice origin.

## Stand structure

| Stand structure | Code | Definition |
|---|---|---|
| Temporarily without trees | 0 | Forest temporarily without trees as a result of human intervention or natural causes |
| Even-aged stand | 1 | Even-aged forest |
| Two storeyed stand | 2 | Forest clearly divided into an overstorey and an understorey |
| Uneven-aged stand | 3 | Uneven-aged forest, the trees distributed into several layers |

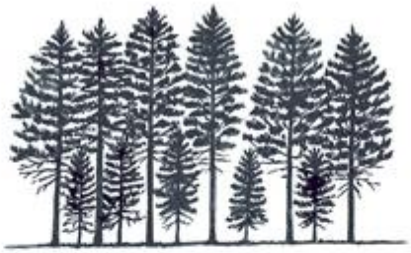
Even-aged stand:
Forest in which the predominant proportion of the trees falls into the same age class, generally resulting in a single storey forest. The age difference between the oldest and youngest trees should as a guideline be less than 20% of the stand age when mature. Even-aged stands are usually produced by cutting all trees within a relatively short period, by natural disturbances that eliminate most vegetation in the previous stand, or by systematically removing all trees except from one specific age class.

Two storeyed (two-aged) stand:
Forest clearly divided into an overstorey and an understorey. The age difference between the oldest and youngest trees should as a guideline be at least 20% of the stand age when mature.

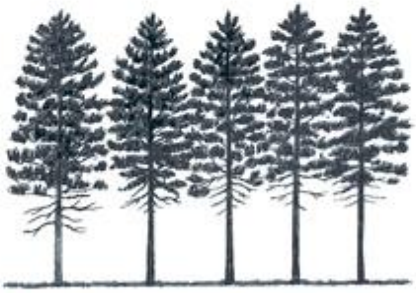
Uneven-aged stand:
Forest in which there is a mixture of different age classes. Usually, the trees cannot be separated into different storeys. This can be either achieved through selection treatment interventions or naturally in mixed species stands, where species with different growth performance and top heights have been established.



**Uneven-aged**: a stand with trees of three or more distinct age classes, either intimately mixed or in small groups.



**Two-aged**: a stand with trees of two distinct age classes separated in age by more than plus or minus 20% of the rotation age.



**Even-aged**: a stand composed of a single age class of trees in which the range of tree ages is usually plus or minus 20% of the rotation age.

## Treatment opportunity class

Treatment opportunity identifies the physical opportunity to improve stand conditions by applying management practices. The need for forest intervention that already exists or is expected to emerge during the next 5 years should be decisive for this assessment.

| Treatment opportunity class | Code | Definition |
|---|---|---|
| No treatment | 0 | No treatment |
| Regen. without site preparation | 1 | Regeneration without site preparation |
| Regen. with site preparation | 2 | Regeneration with site preparation |
| Conversion | 3 | Stand conversion |
| Cleaning-thinning | 4 | Cleaning-thinning (pre-commercial) |
| Thinning | 5 | Thinning (commercial) |
| Clearcut, strip clearcut harvest | 6 | Clear cut harvest, strip clearcut harvest |
| Selection | 7 | Partial cut harvest, selection felling |
| Salvage/sanitary felling | 8 | Salvage or sanitary harvest |
| Repair planting | 9 | Supplementary planting/seeding |

No treatment:
Stand is characterized by an adequate stock of growing-stock trees in reasonably good condition.

Regeneration without site preparation:
The area is characterized by the absence of a manageable stand because of inadequate stocking of growing stock. Growth will be much below the potential for the site if the area is left alone. Prospects are not good for natural regeneration. Artificial regeneration will require little or no site preparation.

Regeneration with site preparation:
The area is characterized by the absence of a manageable stand because of inadequate stocking of growing stock. Growth will be much below the potential for the site if the area is left alone. Either natural or artificial regeneration will require site preparation.

Stand conversion:
The area is characterized by stands of undesirable, chronically diseased, or off-site species. Growth and quality will be much below the potential for the site if the area is left alone. The best prospect is for conversion to a different forest type or species.

Cleaning-thinning:
The stand is characterized by a dense stocking of seedlings and saplings (pre-commercial). Stagnation appears likely if left alone. Stocking must be reduced to help crop trees attain dominance.

Thinning:
The stand is characterized by a dense stocking of growing stock. Stocking must be reduced to prevent stagnation or to confine growth to selected, high quality crop trees.

Clear cut harvest:
The area is characterized by a mature or overmature sawtimber stand of sufficient volume to justify a commercial harvest. The best prospect is to harvest the stand and regenerate.

This harvesting method is forbidden according the legislation in Kosovo, and demands a special permit. Areas where this harvesting method should be considered is even-aged forest of spruce or degraded forest which needs to be artificially reestablished

Partial cut harvest, selection felling:
The stand is characterized by poletimber or sawtimber size trees with sufficient merchantable volume for a commercial harvest, which will meet intermediate stand treatment needs or prepare the stand for natural regeneration. The stand is of a favored species composition and may be even or uneven aged. Under this code are assigned stands suitable for the selection system to maintain an uneven age stand, including Femelschlag system etc.

Salvage or sanitary felling:
The stand is characterized by excessive damage to merchantable timber because of fire, insects, disease, wind, ice, or other destructive agents. The best prospect is to remove damaged or threatened material.

Repair planting:
The area is insufficiently regenerated (artificially or naturally). Less than 70% of the area is stocked. Additional planting is required to fill gaps and to fully utilise growing space in order to achieve a growth according to the site potential. The treatment applies to stands in the seedling development stage.

## Tree quality

| Tree quality grade | Code | Definition |
|---|---|---|
| High quality | 1 | Big share of high quality sawlogs and veneer wood in the stem |
| High to average quality | 2 | Some high quality and some low quality sawlogs in the stem |
| Average to low quality | 3 | Mostly low quality sawlogs and firewood in the stem |
| Low quality | 4 | Trees of low quality. Large irregularities, bent or forked; firewood |

## Appendix 2: Field record forms

### *PLOT RECORD FORM*

Team leader.....

| | | |
|---|---|---|
| | | |

dd mm yy

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| X | | | | | | | |
| Y | | | | | | | |

Cluster Nr. : Plot no in cluster:

Inventory status (all): Plot Status (f, owl) Size of Partial Plot (f, owl):

| Orientation (all) | Azimuth (º) | Distance (dm) | Type (*comments for easy ID of plot center*) |
|---|---|---|---|
| O. mark 1 | | | |
| O. mark 2 | | | |
| O. mark 3 | | | |

| Elevation (all, m) | Slope (f, owl, %) | Aspect (f, owl, º) | Land use (all) |
|---|---|---|---|
| 0000 | 00 | 000 | 00 |
| | | | |

| | | | |
|---|---|---|---|
| Ownership (f, owl) | *pole* | 0 | |
| Naturalness (f, owl) | *r=20* | 0 | |
| Management class (f, owl) | *r=20* | 0000 | |
| Stand age (f) | *r=20* | 000 | |
| Lorey mean height (f) (dm) | *r=20* | 000 | |
| Current stand origin (f) | *r=20* | 0 | |
| Origin of small trees/regener. (f) | *r=20* | 0 | |
| Stand structure (f) | *r=20* | 0 | |
| Treatment opportunity (f) | *r=20* | 0 | |
| Crown cover percentage (f, owl) (%) | *r=20* | 00 | |
| Litter cover (f, owl) | *r=10* | 0 | |
| Soil type (f, owl) | *r=10* | 0 | |
| Soil depth (f, owl) | *r=10* | 0 | |
| Damage small tree/regeneration (f) | *r=2,5* | 0 | |
| Intensity of damage small/regen. (f | *r=2,5* | 0 | |
| Occurrence of dead biomass (f, owl) | *r=10* | 0 | |
| Occurrence of junipers (f, owl) | *r=10* | 00 | |

| Tree species composition (f, owl) (%) *r=20* 00 | | | | | | |
|---|---|---|---|---|---|---|
| 11 | 12 | 13 | 19 | 21 | 22 | 29 |
| | | | | | | |

| | | |
|---|---|---|
| Regeneration (0) *r=2,5* | Coniferous | |
| | Broadleaves | |

| | | |
|---|---|---|
| No. of trees w. dbh < 3,5 (*r=2,5*) | Conifer-ous | |
| | Broad leaved | |

| | | |
|---|---|---|
| No.of trees 7> dbh >=3,5 (*r=2,5*) | Conifer -ous | |
| | Broad leaved | |

| ***Litter cover*** | *Code* |
|---|---|
| 0 - 2 cm | 1 |
| 2-4 cm | 3 |
| 4 - 6 cm | 5 |
| 6 – 8 cm | 7 |
| > 8 cm | 9 |

| ***Soil type*** | *Code* |
|---|---|
| Mineral soil | 1 |
| Organic soil | 2 |

| ***Soil depth*** | *Code* |
|---|---|
| < 25 cm | 1 |
| 25 - 50 cm | 2 |
| 50 - 80 cm | 3 |
| > 80 cm | 4 |

| ***Damage small/regener*** | *Code* |
|---|---|
| None | 0 |
| Insect | 1 |
| Disease/fungus | 2 |
| Fire | 3 |
| Animal | 4 |
| Weather | 5 |
| Human impact | 6 |
| Suppression | 7 |
| Miscellaneous | 8 |

| ***Intensity of damage*** | *Code* |
|---|---|
| 0 – 5 % | 0 |
| 6 – 25 % | 1 |
| 26 – 50 % | 2 |
| 51 – 75 % | 3 |
| 76 – 100 % | 4 |

| ***Dead biomass*** | *Code* |
|---|---|
| No dead biomass | 0 |
| Dead biomass | 1 |

| ***Management. class*** | *Code* |
|---|---|
| see separate code form | |

| ***Plot number*** | *Code* |
|---|---|
| 2 3 / 1 4 | 1 |
| | 2 |
| | 3 |
| | 4 |

| ***Inventory status*** | *Code* |
|---|---|
| Visit, old centre found | 11 |
| Visit, old centre not found | 12 |
| Not visit, map/photo class | 21 |
| Not visit, visual assessm | 22 |

| ***Plot status*** | *Code* |
|---|---|
| Full plot | 1 |
| Partial plot | 2 |

| ***Land use class*** | *Code* |
|---|---|
| Forest | 01 |
| Other wooded land | 10 |
| Cropland | 30 |
| Grassland | 31 |
| Settlements | 40 |
| Water | 50 |
| Other wetlands | 51 |
| Other land | 20 |

| ***Ownership status*** | *Code* |
|---|---|
| Unknown | 0 |
| Public | 1 |
| Private | 2 |

| ***Naturalness*** | *Code* |
|---|---|
| Undisturbed by man | 1 |
| Semi-natural forest | 2 |
| Plantation | 3 |

| ***Tree species comp.*** | *Code* |
|---|---|
| Fir | 11 |
| Spruce | 12 |
| Pine | 13 |
| Other conifers | 19 |
| Beech | 21 |
| Oak | 22 |
| Other broadleaves | 29 |

| ***Current stand origin*** | *Code* |
|---|---|
| No existing stand | 0 |
| Natural seeding | 1 |
| Planting or artific.seeding | 2 |
| Coppice | 4 |
| Coppice with standards (middle forest) | 5 |

| ***Origin of small/regene*** | ***Code*** |
|---|---|
| No existing small/ regener | 0 |
| Natural seeding | 1 |
| Planting or artific.seeding | 2 |
| Coppice | 4 |

| ***Stand structure*** | *Code* |
|---|---|
| Temp. without trees | 0 |
| Even-aged stand | 1 |
| Two storeyed stand | 2 |
| Uneven-aged stand | 3 |

| ***Treatment opportunity*** | ***Code*** |
|---|---|
| No treatment | 0 |
| Regen.without site prep. | 1 |
| Regen.with site prep. | 2 |
| Conversion | 3 |
| Cleaning-thinnng | 4 |
| Thinning | 5 |
| Clearcut | 6 |
| Selection | 7 |

# KOSOVO NATIONAL FOREST INVENTORY – 2012

## *TREE RECORD FORM*

Team leader:.....

Date: ☐☐☐ Day mm yy  Cluster Nr: ☐☐☐ 001-999  Plot No: ☐ 1-4

| Tree number | Tree species | Tree status | Azimuth (°) | Distance (cm) | Diameter h. 1.3 (mm) | Vol. reduction 00 – 99 (%) | Damage | Tree quality | Tree type | Tree height (dm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 000 | 000 | 0 | 000 | 0000 | 0000 | 00 | 0 | 0 | 0 | 000 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | |

## Appendix 3: List of personnel involved in the NFI 2012

*Project team, Norwegian Forestry Group:*

| Name | Main responsibilities |
|---|---|
| Orhan Berisha | Geographic information management, fieldwork, data quality control |
| Erling Bergsaker | NFI reporting. Calculation of annual allowable cut. |
| Tormod Dale | Training. Data quality control. NFI reporting. |
| Svein Dypsund | Programming field PDAs |
| Jens Kolstad | Database management. Geographic information management |
| Ibrahim Muja | NFI coordination. Fieldwork support. Data quality control. Translation. |
| Dr. Stein M. Tomter | Methodology development. Calculation of results. NFI reporting. |

*External support:*

| Name | Organisation | Tasks |
|---|---|---|
| Tahir Ameti | Leader of Section, Department of Forestry, Ministry of Agriculture, Forestry and Rural Development/NFG | Methdology development support |
| Kemajl Kadriu | Leader of Section, Department of Forestry, Ministry of Agriculture, Forestry and Rural Development/NFG | Ortophoto interpretation for preliminary classification. Data entry. |
| Dr. Nenad Petrovic | Assistant Professor, Faculty of Forestry, University of Belgrade | Translation |
| Ahmet Zejnullahu | Managing director, Kosovo Forest Authority | Steering committee leader |

*NFI fieldworkers:*

| Team leader | Field assistant |
|---|---|
| Orhan Berisha (field coordinator) | Esat Dautaj |
| Branko Bojovic | Slobodan Jelenic |
| Rrustem Dautaj | Beqe Mehmetaj |
| Fitim Hoxhaj | Agron Shkodra |
| Osman Hasani | Ekrem Krasniqi |
| Bedri Beluli | Shkodran Krasniqi |