ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

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Projet cofinancé par le Fonds Européen de Développement Régional (FEDER)
Project cofinanced by the European Regional Development Fund (ERDF)

RAPPORTI

Structural diversity of forests in Lazio

183/2013

ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale
Via Vitaliano Brancati 48
00144 Roma
http://www.isprambiente.gov.it

ISPRA, Rapporti 183/2013
ISBN 978-88-448-0618-7

Graphics
ISPRA

Cover graphics: Alessia Marinelli
Cover photos: Franco Iozzoli and Paolo Orlandi

Editor coordination:
Daria Mazzella
ISPRA – Settore Editoria

First published: July 2013

Citation

Bianco P, and Ciccarese L (2013) *Structural diversity of forests in Lazio*. Rapporti 183. ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale, Roma, 67 p. ISBN 978-88-448-0618-7

Nature Conservation Department, Italian Institute for Environmental Protection and Research (ISPRA)

Via Vitaliano Brancati 48, 00144 Rome, Italy

Telephone +39 06 50074824

Fax +39 06 50075618

E-mail address of the corresponding author: lorenzo.ciccarese@isprambiente.it

ACKNOWLEDGEMENTS

The report was supported by project "Promotion and renewable energy and improvement of energy efficiency" (acronym: PROFORBIOMED, www.proforbiomed.eu), a strategic MED project under the transational European Territorial Cooperation programme, that meets the objective 2.2. "Promoting renewable energy and improving energy efficiency."

The project is linked to the promotion of the use of renewable energies by the development of an integrated strategy for the use of the forest biomass as a renewable energy source that demonstrates, apply and transfer sustainable management systems adapted to the different MED forest conditions.

The strategy relies on the valorisation of the forests and their consideration as potential source of incomes in rural areas that need proper management and maintenance (in environmental terms). It implies the involvement of all stakeholders of rural areas, the development of clusters and networks and the strengthening of the cooperation between public and private actors, developing political and social commitments and joint initiatives.MED Programme is a EU transnational cooperation programme among the "Territorial Cooperation objective" of the EU Cohesion Policy.

PROFORBIOMED involves 18 partners, including 4 national bodies, 5 regional bodies and 3 local authorities (and other 6 different structures) from 5 different countries: Greece, Italy, Portugal, Slovenia and Spain.

The authors of this report acknowledge the contribution of Mariangela Soraci (ISPRA) in Chapter 3 and for reviewing the text of this report. They also acknowledge the advice provided at various stages during the project and preparation of the report by Roberto Daffinà, Deanna De Taddeo, Piera Pellegrino, and other ISPRA colleagues and experts outside ISPRA. A special thank goes to Antonio Brunori (Comunicambiente.net) and Diego Florian (FSC Italy) for their contribution on Chapter 8.

SUMMARY

ABBREVIATIONS AND ACRONYMS

CAI	Current Annual Increment (m^3 ha^{-1} $year^{-1}$)
CAP	Common Agricultural Policy
EC	European Commission
CFS	Corpo Forestale dello Stato (Italian Forest Service)
CLC	Corine Land Cover
CORINE	Coordination de l'Information sur l'Environnement
D	Wood density
d.m.	Dry matter
EEA	European Environment Agency
EUROSTAT	Statistical Office of the European Communities
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
GHG (s)	greenhouse gas (es)
GIS	geographic information system
GPS	global positioning system
GS	growing stock
INFC	Inventario Nazionale delle Foreste e del Carbonio (National Inventory of Forests and Carbon)
ISPRA	Istituto Superiore per la Protezione e la Ricerca Ambientale
ISTAT	Istituto Nazionale di Statistica (Italy's Statistics Office)
MAI	Mean annual increment (m^3 ha^{-1} $year^{-1}$)
MCPFE	Ministerial Conference on the Protection of Forests in Europe
Mtoe	Million tonnes of oil equivalent
n.a.	not available
NAI	Net annual increment (m^3 ha^{-1} $year^{-1}$)
NPP	Net primary production
NWFP (s)	Non-wood forest product (s)

OWL	Other Wooded Land
PHL	Potential Harvesting Level
R/S	Root-to-shoot ratio
RS	Remote Sensing
SFM	Sustainable Forest Management
SOM	Soil Organic Matter
SRF	Short Rotation Forestry
SRP (s)	Short Rotation Plantation (s)
UAA	Utilised Agricultural Area
UN	United Nations
UWET	Unified Wood Energy Terminology, Definitions and Conversion Factors
WEIS	Wood Energy Information System

UNITS OF MEASURE AND CONVERSION FACTORS

Cubic meter	m^3
Hectare	ha
Megatonne (10^6 tonnes)	Mt
Meter (s)	m
Million (s)	M
Tonne (s)	t
Year	yr
1 Gg biomass (oven-dry)	18.6 TJ
1 m^3 wood (oven-dry)	8.714 GJ
1 toe	41.87 GJ

GLOSSARY

BELOWGROUND BIOMASS All living biomass of live roots. Fine roots of less than 2 mm diameter are normally excluded (as they often cannot be distinguished empirically from soil organic matter or litter).

BIODIVERSITY The variety of life on Earth, including diversity at the genetic level, among species and among ecosystems and habitats. It includes diversity in abundance, distribution and behaviour. Biodiversity also incorporates human cultural diversity, which can both be affected by the same drivers as biodiversity, and itself has impacts on the diversity of genes, other species and ecosystems.

BIOFUEL Fuel produced from dry organic matter or combustible oils from plants, such as alcohol from fermented sugar or maize, and oils derived from oil palm, rapeseed or soybeans.

BIOMASS Organic material both aboveground and belowground, and both living and dead, e.g., trees, crops, grasses, tree litter, roots etc. Biomass includes the pool definition for above - and below - ground biomass. When used in reference to renewable energy, biomass is any biological (plant or animal) matter that can be converted to electricity or fuel. Woody biomass refers to biomass material specifically from trees and shrubs. It is most often transformed to usable energy by direct combustion, either alone or co-fired with coal; however, efforts are underway to develop methods to cost effectively convert woody material to liquid fuels.

BIOMASS ACCUMULATION RATES Net build up of biomass, i.e., all increments minus all losses. When carbon accumulation rate is used, only one further conversion step is applied: i.e., the use of 50% carbon content in dry matter (IPCC default value).

BIOMASS EXPANSION FACTOR (BEF) A multiplication factor that expands growing stock, or commercial round-wood harvest volume, or growing stock volume increment data, to account for non-merchantable biomass components such as branches, foliage, and non-commercial trees.

CANOPY The topmost layer of foliage and branches in a woodland, tree or group of trees.

CANOPY COVER The percentage of the ground covered by a vertical projection of the outermost perimeter of the natural spread of the foliage of plants. Cannot exceed 100% (Also called crown closure). Same as crown cover.

CARBON DIOXIDE EQUIVALENT A measure used to compare different greenhouse gases based on their global warming potentials (GWPs). The GWPs are calculated as the ratio of the radiative forcing of one kilogramme greenhouse gas emitted to the atmosphere to that from one kilogramme CO_2 over a period of time (usually 100 years).

CARBONS STOCK The quantity of carbon in a pool.

CARBON STOCK CHANGE The carbon stock in a pool can change due to the difference between additions of carbon and losses of carbon. When the losses are larger than the additions, the carbon stock becomes smaller and thus the pool acts as a source to the atmosphere; when the losses are smaller than the additions, the pools acts as a sink to the atmosphere.

COMPLEMENTARY FELLINGS The additional potential for fellings on top of regular fellings, e.g. the difference between the maximum sustainable harvest level and the actual harvest.

COPPICE A growth of small trees that are repeatedly cut down at short intervals; the new shoots are produced by the old stumps. Coppicing represents a traditional method of woodland management and wood production, in which shoots are allowed to grow up from the base of a

felled tree. Trees are felled in a rotation. Rotation lengths of coppices depend on the desired size and quality of poles and are typically 10-30 years depending on species and site. A coppice may be large, in which case trees, usually oak (*Quercus*), ash (*Fraxinus*) or *Ostrya*, are cut, leaving a massive stool from which up to 10 trunks arise; or small, in which case trees, usually hazel (*Corylus*) or willow (*Salix*), are cut to leave small, underground stools producing many short stems. The system provides a continuous supply of timber for fuel, fencing, etc., but not structural timber.

COPPICE WITH STANDARDS A traditional system of woodland management whereby timber trees are grown above a coppiced woodland. It is used in particular as a method of exploiting oak woods, in which all the trees except a rather open network of tall, well-formed oaks - the standards at about fifty per hectare - are felled, leaving plenty of space for other underwood to grow and be coppiced at intervals of ten to twenty years.

CROPLAND Category of land-use that includes arable and tillage land, and agro-forestry systems where vegetation falls below the threshold used for the forest land category, consistent with the selection of national definitions.

DEAD WOOD Includes all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country.

DRY MATTER (d.m.) Dry matter refers to biomass that has been dried to an oven-dry state, often at 70 °C. Dry matter includes all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil.

FELLING CYCLE The planned period, in years, within which all parts of a forest zoned for wood production and being managed under a selection silvicultural system should be selectively cut for logs. The term is synonymous with Cutting Cycle.

FOLIAGE The live leaves or needles of the tree; the plant part primarily responsible for photosynthesis.

FOREST According to the Italy's National Inventory of Forests and Carbon (INFC) forest is a land spanning more than 0.5 ha with trees higher than 5 m and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use. Forest may consist either of *closed* forest stands where trees of various storeys and undergrowth cover a high proportion of the ground; or of *open* where forest formations with continuous vegetation cover in which tree crown cover exceeds 10 percent. Forest can be open forest or closed forest. Young forest stand, even if derived from planting, or areas that are temporarily unstocked due forest management practice or natural disturbances, and which are expected to be regenerated within a short period of time, are considered forest. Forest also 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, 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. Plantations and cork oak stands are included.

FOREST AVAILABLE FOR WOOD SUPPLY Forest where any legal, economic or specific environmental restrictions do not have a significant impact on the supply of wood.

FOREST INVENTORY System for measuring the extent, quantity and condition of a forest, usually by sampling.

FOREST MANAGEMENT A system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner.

FOREST RESIDUES Residues resulting from tree harvesting (thinnings or regeneration fellings), e.g. those parts of the tree that are not removed in the roundwood extraction (stem top and stump, branches, foliage and roots). In this study the assessment of biomass potentials from forest residues is limited to stem tops and branches.

FORMATIVE PRUNING The trimming of a tree to remove weaknesses and irregularities, which may lead to problems for the tree itself. The formative pruning operation is aimed at reducing the potential for future weaknesses or problems within the tree's crown.

GRASSLAND Category of land-use which includes rangelands and pasture land that is not considered as cropland. It also includes systems with vegetation that fall below the threshold used in the forest land category and is not expected to exceed, without human intervention, the thresholds used in the forest land category. This category also includes all grassland from wild lands to recreational areas as well as agricultural and silvo-pastoral systems, subdivided into managed and unmanaged, consistent with national definitions.

GROWING STOCK The living tree component of the standing volume (measured in m^3 overbark).

LAND COVER The type of vegetation covering the earth's surface.

LAND USE The type of activity being carried out on a unit of land.

LITTER Includes all non-living biomass with a diameter less than a minimum diameter chosen by the country (for example 10 cm), lying dead, in various states of decomposition above the mineral or organic soil. This includes litter, humic, and humic layers. Live fine roots (of less than the suggested diameter limit for belowground biomass) are included in litter where they cannot be distinguished from it empirically.

NET ANNUAL INCREMENT Average annual volume over the given reference period of gross increment minus natural losses (mortality, etc.) of all trees to a specified minimum diameter at breast height.

OTHER WOODED LAND According to the Italy's National Forest Inventory, Other Wooded Land is a land not defined as forest, spanning more than 0.5 ha; with trees higher than 5 meters and a canopy cover of 5-10 %, or trees able to reach these thresholds; or with a combined cover of shrubs, bushes and trees above 10 percent. Sub-categories of OWL are low woods, sparse woods, bushes, shrubs, and inaccessible forest areas.

PASTURE Grassland managed for grazing.

POOL/CARBON POOL A reservoir. A system which has the capacity to accumulate or release carbon. Examples of carbon pools are forest biomass, wood products, soils and the atmosphere. The units are mass.

PRE-COMMERCIAL Cultural practice aimed at lowering stand densities and improving growing conditions for the remaining trees. Dense forest tree populations are thinned so trees do not compete for limited resources such as nutrients, sun and moisture. Stands are typically thinned between the ages of three and twelve years of age. Excess trees are removed mechanically or manually, depending on the site conditions.

PRIMARY ENERGY CONSUMPTION Indicates how much energy is directly available for use in the country (such as electricity imported or produced by hydroelectric power plants), or indirectly available after having been converted into products to be sent to the end market (such as crude oil, which goes to refineries to be transformed into petrol or diesel oil) or having been transformed into electricity (for example, fossil fuels utilised by thermoelectric power plants to produce electricity).

PRUNING The cutting off or removal of dead or living parts or branches of a plant to improve shape or growth.

REGULAR COPPICE Shoots, once mature, are felled close to the ground, so as to produce shoots from the resulting stools.

REMOTE SENSING Practice of acquiring and using data from satellites and aerial photography to infer or measure land cover/use. May be used in combination with ground surveys to check the accuracy of interpretation.

REMOTELY SENSED DATA Data generally acquired by means of scanners or cameras onboard aircraft or satellites.

REMOVALS Removals are a subset of fellings (the commercial part destined for processing).

ROTATION The planned number of years between the establishment of a crop (by planting or regeneration) and final felling. The term is applied where forest is managed under a monocyclic silvicultural system.

SETTLEMENTS This category includes all developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories. This should be consistent with the selection of national definitions.

SHORT ROTATION FORESTRY (SRF) It is a forest production practice of dendromass by cultivating fast-growing trees that reach their economically optimum size between few years, from 2 to 15 years. SRF employs intensive cultural techniques such as fertilization, irrigation and weed control, and utilises genetically superior planting material, relying on coppice regeneration. In literature many definitions have been used to identify SRF: short-rotation woody crops, short- rotation intensive culture, short rotation forestry, short-rotation coppice, intensive culture of forest crops, intensive plantation culture, and biomass and/or bioenergy plantation culture. The concept has evolved over the years. Now it can be meant as a forest plantation at a tree density between 1,100 and 16,000 plants/ha and coppiced from 1 to 5 years, with a length inversely proportional to the planting density. The duration of the planting is provided up to a maximum of 15-20 years.

SHORT ROTATION COPPICE (SRC) It is an intensive SRF practice using fast-growing tree species with ability to coppice from harvested stumps, i.e., new shoots can emerge from the rootstocks or stools. Harvests are performed in short intervals (2--6 years) depending on plant material, growth conditions and management practices. Planting, maintenance and harvesting is predominantly done by established agricultural practices allowing farmers to use methods and machines already known from annual crops. According to this definition, SRC falls within SRF and simply represents a more specialized practice of SRF.

SINK Any process, activity or mechanism which removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas from the atmosphere. Notation in the final stages of reporting is the negative (-) sign.

SOIL ORGANIC MATTER Includes organic carbon in mineral and organic soils (including peat) to a specified depth chosen by the country and applied consistently through the time series. Live fine roots (of less than the suggested diameter limit for below- ground biomass) are included with soil organic matter where they cannot be distinguished from it empirically.

STANDING VOLUME Volume of standing trees, living or dead, above stump measured overbark to a predefined top diameter. Includes all trees with diameter above a given diameter at breast height (dbh). The minimum dbh and the top diameter vary by country and are usually country defined.

SUSTAINABLE YIELD The equilibrium level of production from the growth rate of trees comprising a forest, annually or periodically, in perpetuity. It means the continuous production with the aim of achieving an approximate balance between net growth of a forest and harvest.

WETLANDS Category of land use which includes land covered or saturated by water for all or part of the year (e.g., peat-land) and that does not fall into the forest land, cropland, and grassland or settlements categories. This category can be subdivided into managed and unmanaged according to national definitions. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.

WOOD DENSITY Ratio between oven dry mass and fresh stem-wood volume without bark. It allows the calculation of woody biomass in dry matter mass.

YIELD DETERMINATION The calculation, by volume or by area (or a combination of both), of the amount of forest produce that may be harvested annually, or periodically, from a specific area of forest over a stated period, in accordance with the objects of management.

YIELD PLANNING The allocation over time of land units within a productive forest for harvesting in a manner calculated to yield sustainable amounts of logs and other products, while ensuring the maintenance and regeneration of the forest's productive capacity which may be required to support that production.

1. INTRODUCTION

Energy security, global warming, periodic rising prices of fossil fuels, and the need to develop mechanism for rural development have been driving a renewed interest in biomass-based energy production. The European Union (EU) is on a course to increase bioenergy production substantially. The Renewable Energy Directive (RED) adopted in 2009 sets binding targets for renewable energy: 20% share of renewable energy in the EU overall energy consumption by 2020 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=Oj:L:2009:140:0016:0062:en:PDF). Bioenergy is a focal point in this effort, as it is expected to be the main contributor to the 2020 target, with an anticipated contribution of more than half of the 2020 renewable energy target.

Every EU member state has to reach individual targets for the overall share of renewable energy in energy consumption. For Italy this target amounts to 17% of the gross final consumption of energy. In order to comply with the objective, in 2009 the Ministry of Economic Development has given off the National Action Plan for renewable energies. One of the plan's main objectives is to reach, by the end of 2015, an economic potential of 4 million tonnes (Mt) of dry matter (d.m.) per year (yr^{-1}); and, by the end of 2020, of 10 Mt d.m. yr^{-1}. Furthermore, the plan calls for the identification of priorities of end-use of biomass other than energy and, particularly, for integrating criteria assessing the sustainable use of biomass when making plans for agro-energy chains, including the forest-timber-energy one. Interestingly, alongside the objectives related to the mandatory national overall targets and measures for the use of energy from renewable sources, local authorities can take on a voluntary basis for concrete commitments to reduce emissions of greenhouse gases, adhering to the so-called *Patto dei Sindaci* (or Covenant of Mayors). The initiative commits the signatory municipalities to prepare an Action Plan for Sustainable Energy (PAES) with the goal of reducing, by 2020, greenhouse gas emissions by 20% through policies and measures aimed at increasing inter alia, the use of local renewable energy sources, including forest biomass (see http:// www.pattodeisindaci.eu).

In this context, it is of strategic importance, especially for the governments of the municipalities in mountainous forest areas, to have a proper analysis of the potential for domestic production of forest biomass allocable to the production of energy. In this respect, lack of proper information and data frequently prevents assessment of the biological, and full economic and social potential of bio-energy production, including wood energy feedstocks and biomass recovered from forest operations like thinning and pruning.

The scope of this report is to provide policymakers the needed information and data to develop clear regional-level policy goals for forests and energy that reflect the principles of sustainable development and sustainable forest management. It should serve as a basis for developing a method for assessing the biological and socio-economic amount of forest and out-of-forest biomass that can be taken in a sustainable manner (within the limits of natural renewability of the resource) and allocable to the supply of energy plants.

Thus, in this report we firstly describe general features of Lazio, including topography and geology, climate and land use, as well as societal and economic characteristics. The core of the report is the description of Lazio's flora and vegetation and the analysis of the forestland resource base. In particular, we focus on forest types and their distribution, and management types.

2. GENERALITY OF LAZIO

2.1 Topography and Geology

Lazio is one of the 20 administrative regions of Italy and is located in the centre of the peninsula, between about 41°11' and 42°50' North latitude. It comprises a land area of 17,236 km^2, making it the Italy's ninth largest region. Lazio borders Tuscany to the northwest, Umbria and Marche to the north, Abruzzo to the east, Campania to the southeast and the Tyrrhenian Sea to the west. Mountains comprise 26% of the territory, with the highest peak rising to 2,455 m, while hills and plains respectively account for 54% and 20% of the land area.

From the geomorphological and litological point of view Lazio can be divided into four large entities: South and East by the limestone and dolomitic mountains of the Antiapennines (Prenestini, Aurunci, Lepini, Sabini, and Ausoni mountain ranges) and the Apennines (Simbruini, Reatini, Ernici mountain ranges); in the central and in the north parts of the region by volcanic complex of Sabatini, Vulsini, Cimini and Albani hills. Within the province of Viterbo, the Tolfa Mountains, a complex made by flysch and volcanic substrata, are located. Alluvial and mixed beds are in correspondence of Lazio's main rivers (Tevere, the third-longest watercourse in Italy, Aniene, Salto, Turano) and Rieti and Pontina plains.

The Lazio's coast measures about 290 Km in length (excluding the Pontine Islands) of which 74% consists of low coastline and 26% by mountainous coastline. The coast is mainly composed of sandy beaches, punctuated by the headlands of Circeo (541 m) and Gaeta (171 m). The Pontine islands lie nearby the southern coast of Lazio.

At the back of the region's Northern coastal band, the *Maremma Laziale* stretches out from the Tuscany's Maremma up to Civitavecchia, interrupted by the Tolfa Mountains (616 m). The *Campagna Romana* (Rome's Farmland), a vast alluvial plain surrounding the capital city, of approximately 2,100 km^2 occupies the central part of Lazio. The Southern districts are characterized by the lowlands of Agro Pontino, a once swampy and malarial wetland that was reclaimed over the past centuries.

The Preapennines of Lazio, marked by the Tiber valley and the river Liri and its tributary river Sacco, include on the right side of the Tiber three groups of mountains of volcanic origin: the Volsini, the Cimini and the Sabatini mountains, whose largest former craters are occupied by the Bolsena, Vico and Bracciano lakes.

South of the Tiber River, other mountain groups form part of the Preapennines: the Alban hills, also of volcanic origin, and the calcareous Lepini, Ausoni and Aurunci mountains. The Apennines of Lazio are a continuation of the Apennines of Abruzzo: the Reatini Mountains with Terminillo (2,213 m), Mounts Sabini, Mounts Prenestini, Mounts Simbruini and Mounts Ernici, which continue eastward of the Liri into the Mainarde Mountains. The highest peak is Mount Gorzano (2,458 m).

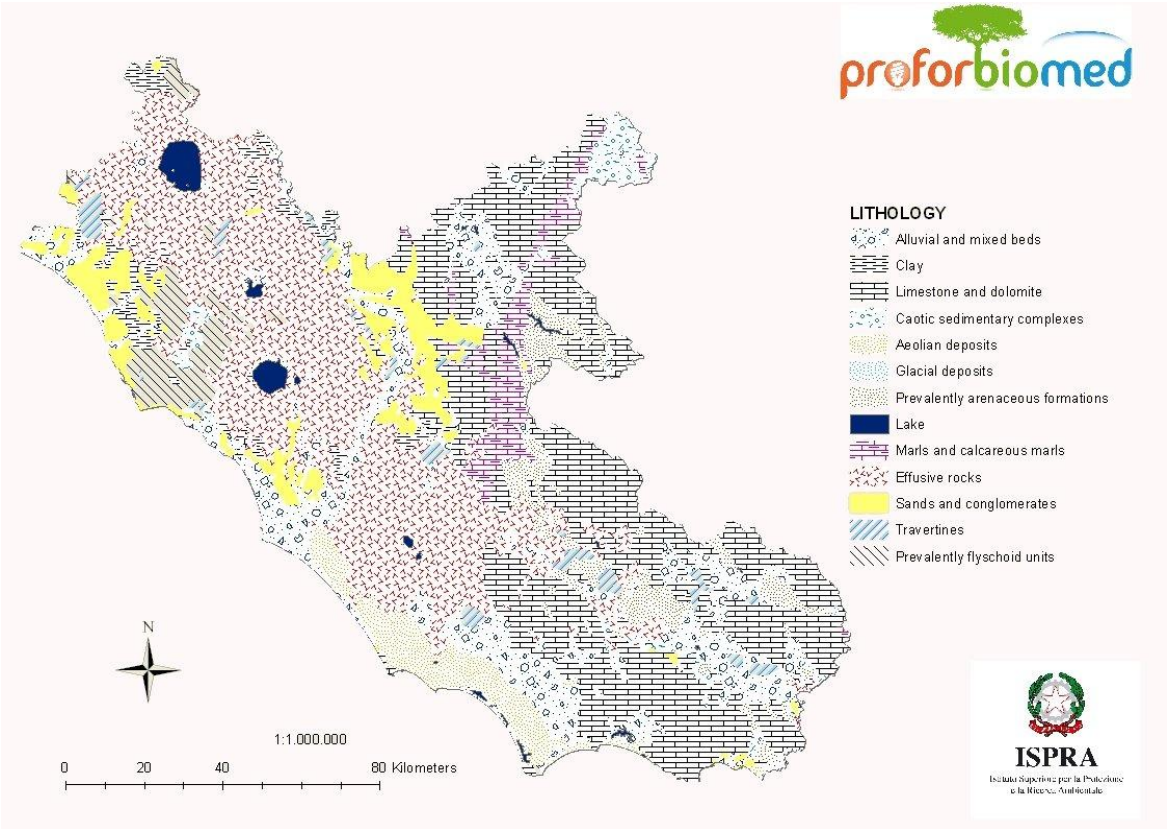

Figure 1. Litology of Lazio. Source: ISPRA

2.2 Climate

Classical literature, throughout the centuries, has always celebrated Lazio for its mild, Mediterranean climate. However the peculiar geographic position and the extreme variability of physical features determine conditions for diverse climatic regimes. The climate is maritime along the coast, temperate in the hill areas and continental in the mountains. The presence of the sea favours oceanic to sub-oceanic conditions in most of flat and hilly areas, as exposed to Western winds.

In Lazio Mediterranean and temperate bioclimatic belt can be primarily distinguished with a large area of transition. Alpine belt is restricted only at the top of the highest Apennine Mountains (Monte Gorzano 2,458 m; Monte Giaccio Porcelli 2,445; Pizzo di Sevo 2,419 m, Pizzo di Moscio 2,411 m). The humid Mediterranean includes the coastal zone and the principal river valley. Most of hilly areas are referred to sub Mediterranean belt (Figure 2). The montane belt is occupied principally by temperate subcontinental pedoclimatic context (Figure 3). Monti Reatini, Duchessa range and Laga Mountains are refered to oro-mediterranean bioclimatic belt.

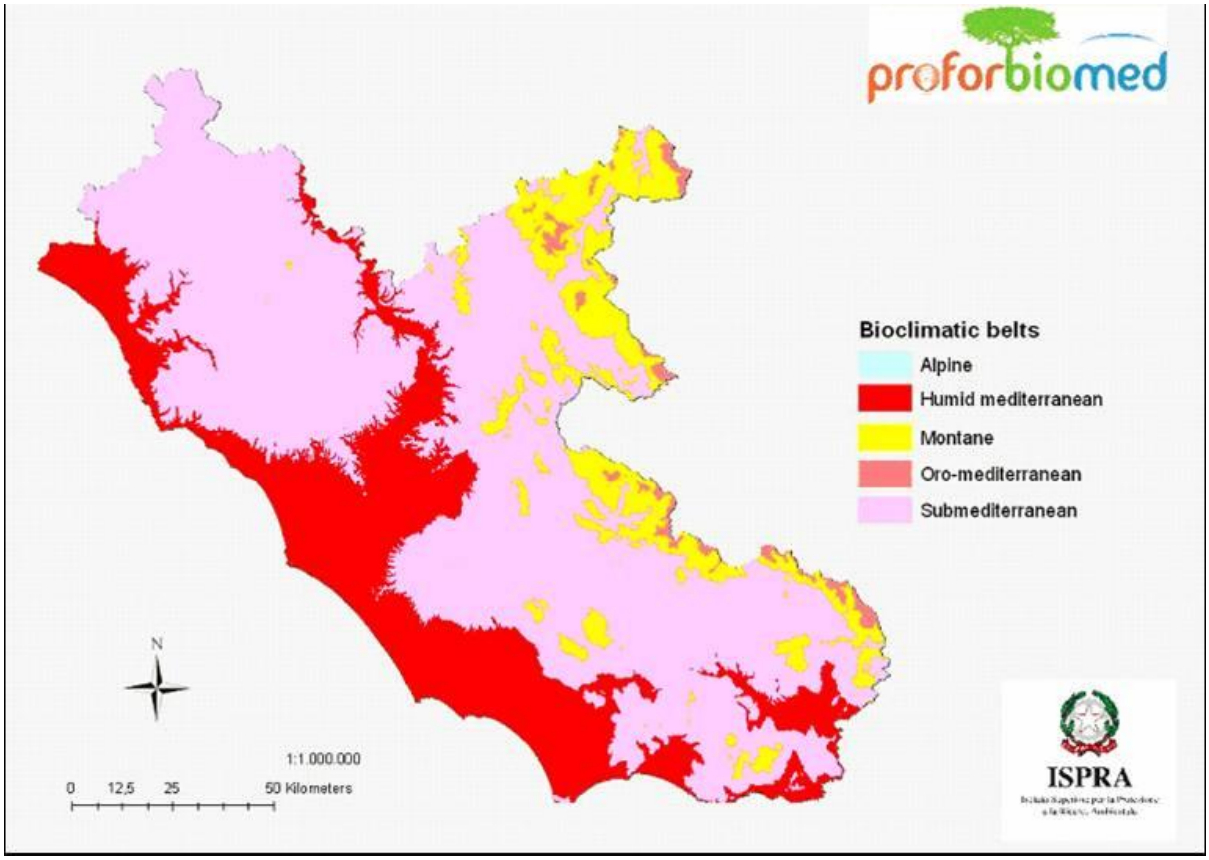

Figure 2. Bioclimatic belts of Lazio

The hottest months are June, July and August, when temperatures reach 30 degrees Celsius (°C); the coldest month is January with temperature often less than 9 °C.

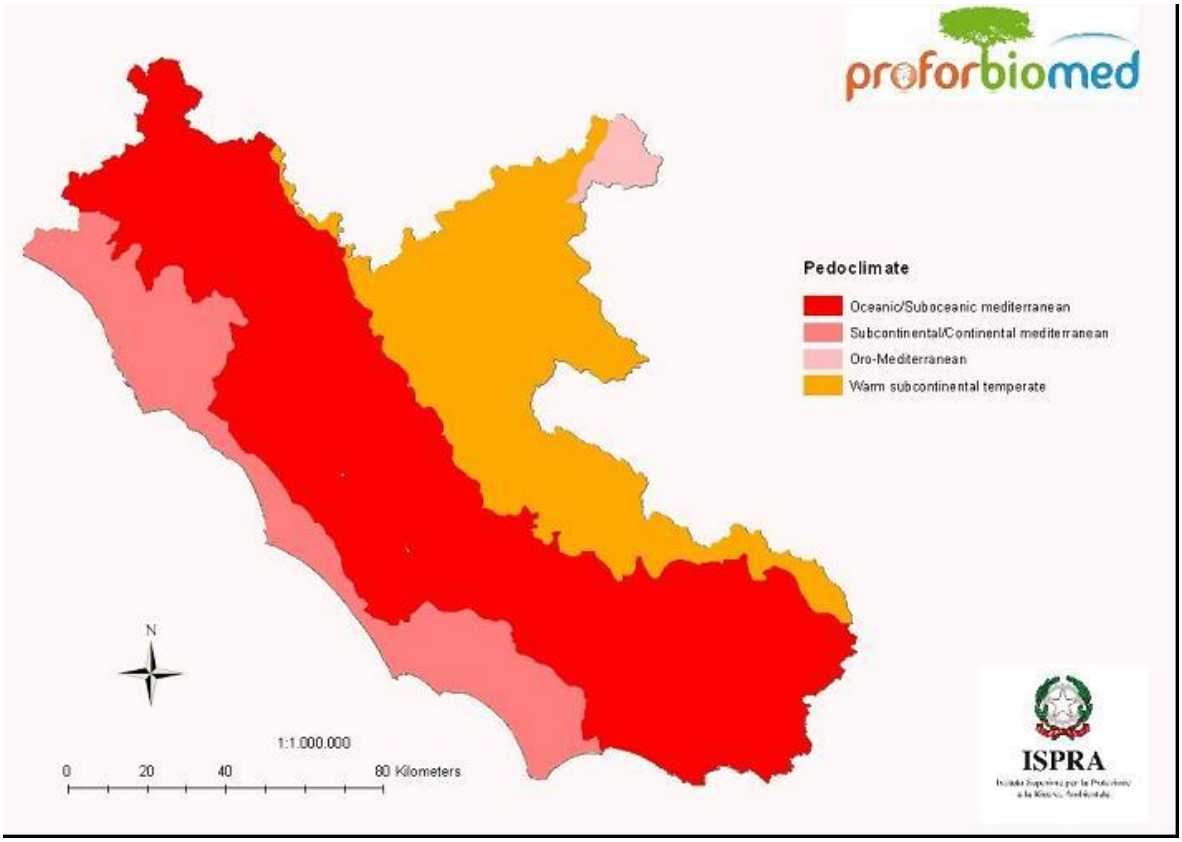

Figure 3. The pedoclimatic zones of Lazio (Source: simplified by data from Centro Nazionale di Cartografia Pedologica, see http://www.soilmaps.it)

Table 1. Climatic data for Rome

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average high, °C	12	13	15	18	23	27	30	30	27	22	16	13
Average low, °C	3	4	5	8	11	15	17	18	15	11	7	4
Average precipitation, mm	103	99	68	65	48	34	23	33	68	94	130	111
Days with rainfall	9	9	9	9	6	5	3	4	6	8	11	10
Hours of sunshine	121	146	167	208	264	295	332	298	245	195	133	112

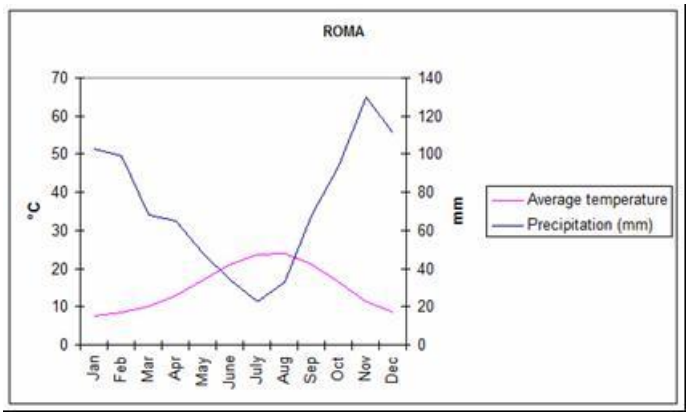

Figure 4. Termopluviometric diagram of Rome

Table 2. Climatic data for Latina

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high, °C	11,1	12,2	16,1	19,4	23,9	27,8	31,1	30,6	27,8	22,2	16,7	13,3	21,1
Average low, °C	2,8	3,3	6,1	8,9	12,8	16,1	18,3	18,3	16,1	11,7	7,2	5,0	10,6
Av. Precipitation, mm	81,3	68,6	73,7	66,0	58,9	40,7	17,8	25,4	66,0	127,0	111,8	99,1	830,6

http://www.climatedata.eu/climate.php?loc=itxx0214&lang=en

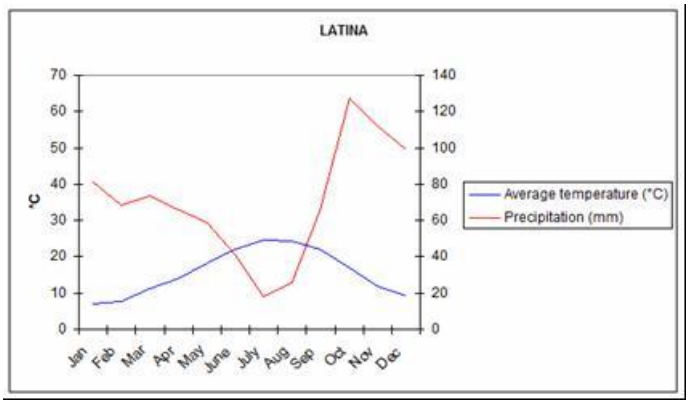

Figure 5. Termopluviometric diagram of Latina

Table 3. Climatic data for Rieti

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high, °C	8	10	13	17	22	25	29	29	25	20	14	9	18,4
Average low, °C	1	0	2	5	8	11	13	13	11	7	4	1	6,3
Precipitation, mm	111	110	95	93	75	70	35	55	87	106	171	146	1154,0

(Source from: Climate-Charts.com)

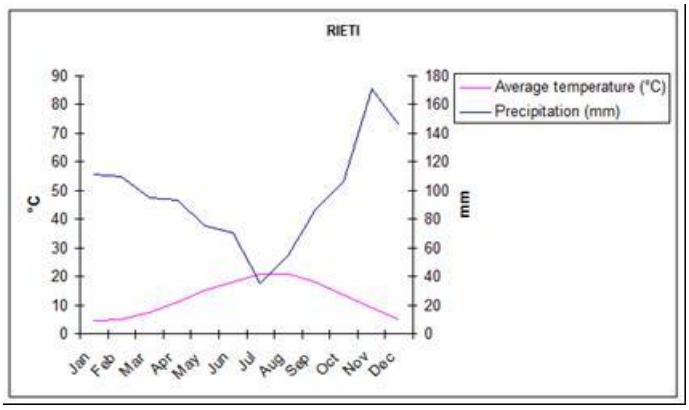

Figure 6. Termopluviometric diagram of Rieti

Table 4. Climatic data for Viterbo

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high, °C	9,5	11,0	13,6	16,5	21,1	25,4	29,1	29,0	25,3	19,9	14,2	10,4	18,8
Average low, °C	0,7	1,8	2,9	5,1	8,5	12,0	14,6	15,1	12,8	9,1	4,7	2,1	7,45
Precipitation, mm	57,0	60,2	49,3	61,0	54,9	57,0	28,5	54,0	57,9	86,7	92,9	68,7	728,1

(Data from: Climate-Charts.com)

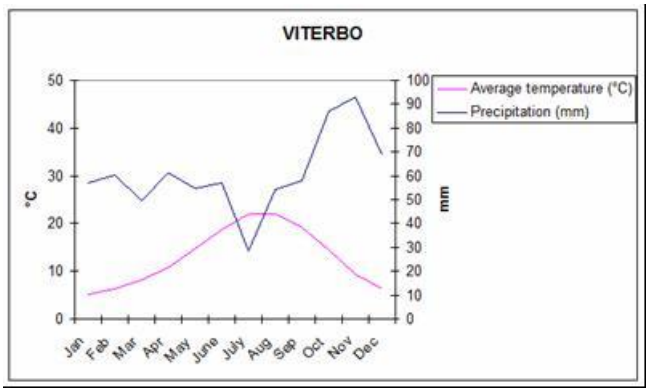

Figure 7. Termopluviometric diagram of Viterbo

Table 5. Climatic data for Frosinone

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high, °C	10,6	12,1	14,7	17,9	22,6	26,6	30,3	30,2	26,5	21,2	15,3	11,5	20,00
Average low, °C	0,5	1,7	3,7	6,1	9,8	13,2	15,8	16	13,4	9,2	5	1,8	8,02
Precipitation, mm	132,6	128,2	100,2	98,9	68,5	50,6	39,9	65,3	95,2	141,7	202,2	175,4	1298,7

(Data from: Climate-Charts.com)

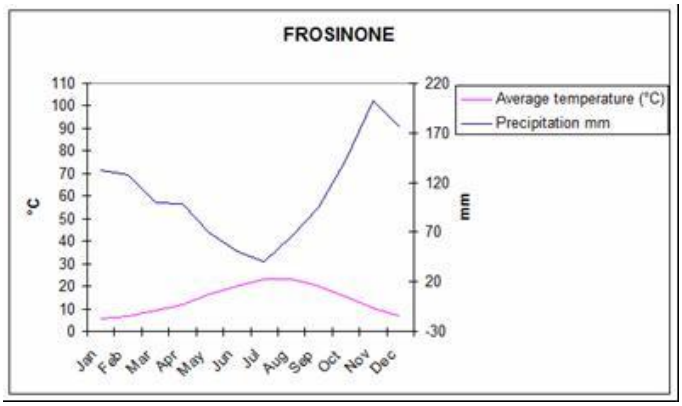

Figure 8. Termopluviometric diagram of Frosinone

2.3 Soils

Land units are extremely fragmented due to the young geological age of the country. Soils are very diverse but certainly not acidic. According to the FAO/UNESCO classification system (1974, 1988) the most widespread groups of soil types are:

- Eutric and Dystric regosols, Dystric and Eutric cambisols, Haplic phaeozems, in the external alpine region;
- Eutric and Dystric Regosol, Haplic phaeozems, Rendzinas, Podzols, Orthic luvisols in the internal part.
- Eutric, Dystric and Calcic cambisols, Eutric fluvisols in the Padanian and main alluvial plains
- Eutric and Calcic cambisols, Eutric regosols, Rendzinas in the northern Apennines
- Calcaric Regosols, Calcic and Eutric cambisol in central and southern Apennines.

A georeferenced database of the soil regions of Italy was developed by the National Center of Soil Cartography in cooperation with the Regional Soil Services and the European Soil Bureau. The data base, scaled 1:5.000.000, is the first informative level for the soil map of Italy at scale 1:250.000; soil regions were delineated according to the criteria of the Manual of Procedures for the georeferenced soil database of Europe, Version 1.0 (European Commission, 1999).

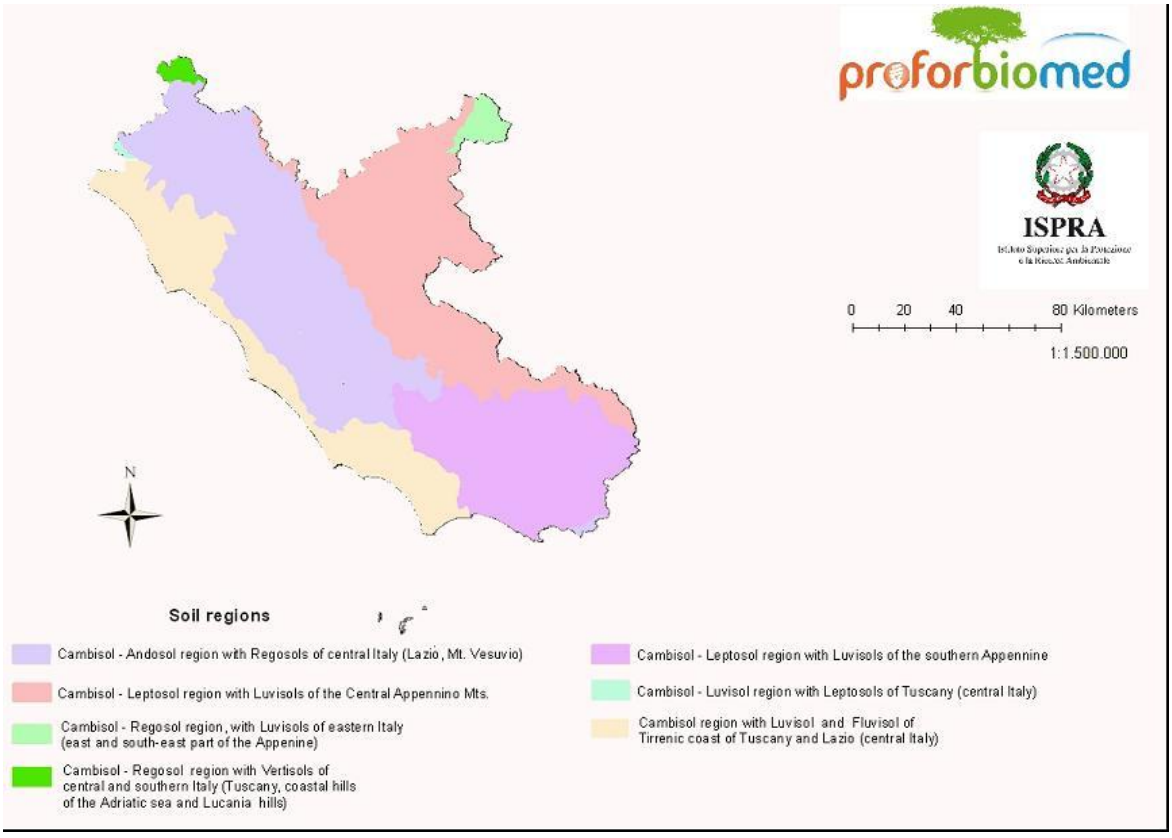

Figure 9. Soil regions in Lazio (Source: Centro Nazionale di Cartografia Pedologica, http://www.soilmaps.it/download/csi-soil_regions.pdf)

2.4 Land cover

As shown in Figure 10, the main land cover category is cropland (47.7%) followed by forestland (28.9%) and settlement (7.9%). Forests are concentrated on mountain range but there are big residual forests at low altitude and along the coasts.

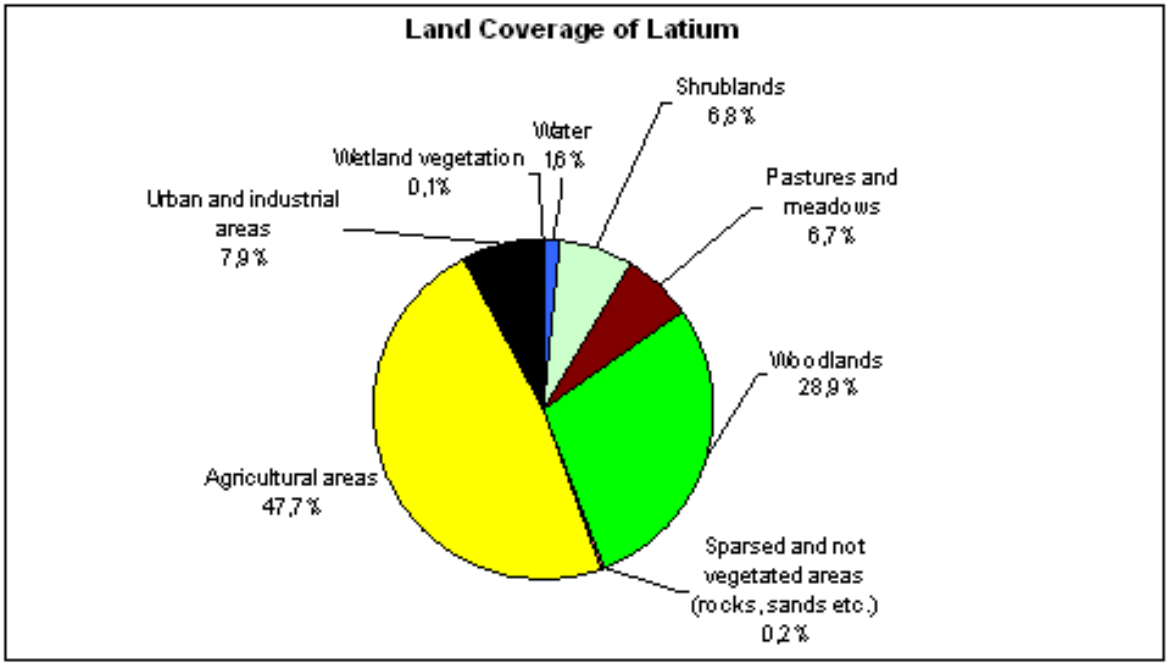

Figure 10. Macrocategory of land cover in Lazio (derived by "Carta della Natura del Lazio", ISPRA 2008)

Shrubland has a relative high value (6.8%) due to afforestation and reforestation processes carried out in the last forty years in abandoned montane and sub-montane lands. Urban and industrial area covers 7.9% of the territory and clustered around Rome, the Pianura Pontina and the Sacco valley.

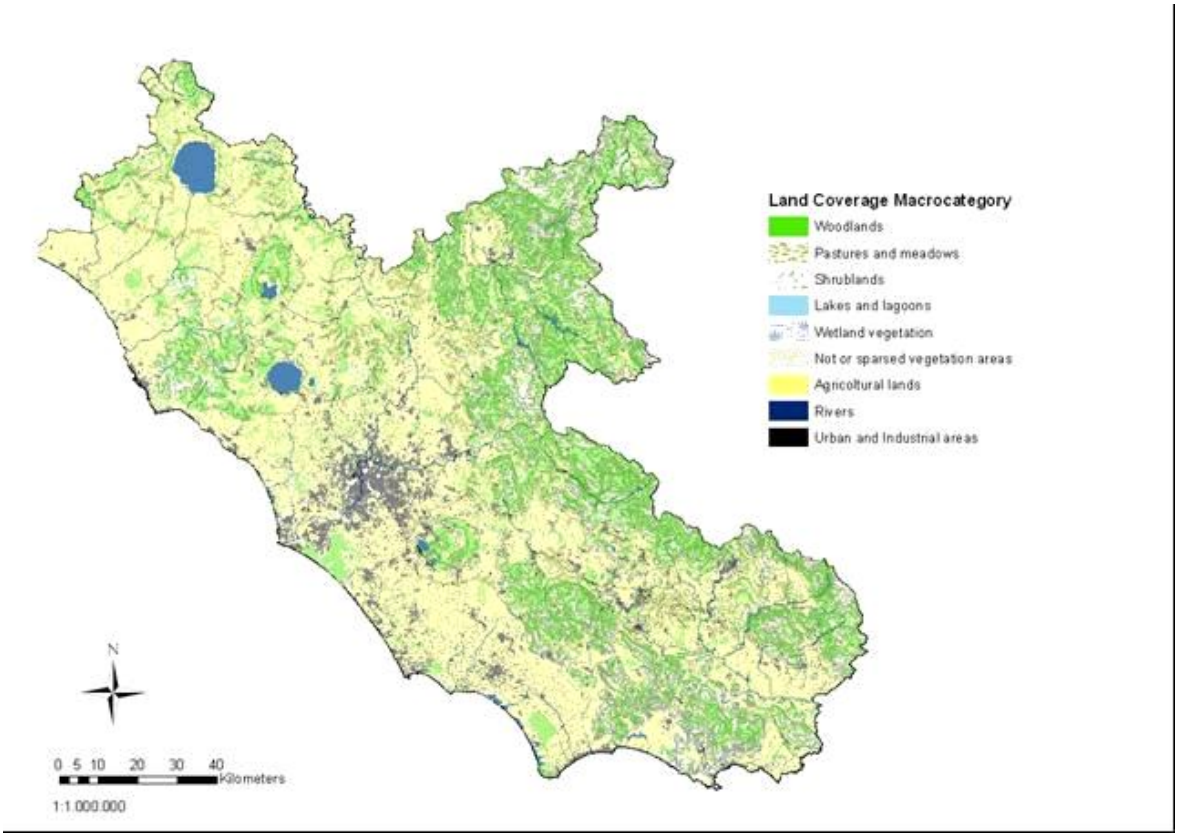

Figure 11. Land cover of Lazio (simplified by Nature Map of Lazio, Casella *et al*. 2008)

2.5 Flora and vegetation

Flora of Lazio includes over 3041 species. There are 164 endemic taxa (5.4% of total flora, 17 are exclusive); 317 species (10.4%) are non-native but became autochthonous[1]. Nine species are protected by Directive 92/43/CEE, and 105 species are endangered at different level of extinction risk (see Scoppola et al. 2005), 10 of them are frequent in forests.

Table 6. Endangered species in forests of Lazio

Species	Red List (Scoppola, & Spampinato 2005)	*Fagus sylvatica* forests	*Quercus cerris* and *Quercus frainetto* forests	*Quercus pubescens* forests	*Quercus ilex* forests
Acer cappadocicum Gled. Subsp. LOBELII (Ten.) Murray ^	LR	*			
Crocus imperati Ten. ^	VU		*		
Cypripedium	LR				

[1] *An autochthonous species is one which normally has been continuously regenerated by natural re generation.*

calceolus L. ^*		*			*
Klasea flavescens (L.) Holub subsp. mucronata (Desf.) Cantó & Rivas Mart. ^	VU				*
Limodorum trabutianum Batt.	VU		*		*
Ophrys fuciflora (Crantz) Mooch subsp. lacaitae (Lojacono) Soó	CR	*			
Vicia barbazitae Ten. & Guss.	VU		*	*	
Vicia pimpinelloides Mauri	LR				*
Vicia dalmatica A Kern.	VU			*	

- endemic, ** Annex II directive 02/43/CEE "Habitat"

Zonal vegetation in Lazio can be attributed to two main large regions: the Eurosiberian and the Mediterranean both belonging to the holoartic realm. The limit between the regions is at around 44° N of latitude, though in Lazio there is a complex East-West gradient of progressive continentality. In each region altitude zoning can be envisaged.

In Lazio the Eurosiberian include the following zones:

- hilly, with deciduous mixed meso-xeric forests (*Quercus petraea*, *Quercus robur*, *Acer pseudoplatanus*, *Fraxinus excelsior*, *Ostrya carpinifolia, Carpinus betulus*, etc.);
- montane, with mixed mesic deciduous forests (*Fagus sylvatica*)

The Mediterranean is subdivided in the following zones:

- thermo- and meso-mediterranean, along with maquis, evergreen sclerophyllous forests (*Quercus ilex*, *Quercus suber*)
- supra-mediterranean, along with deciduous mixed xeric-mesic forests (*Quercus pubesces*, *Quercus cerris*, *Quercus frainetto*, *Acer neapolitanus*, *Fraxinus ornus*, *Carpinus orientalis*);
- oro-mediterranean, mixed mesic deciduous forests (*Fagus sylvatica*)
- crio-oro-mediterranean, along with natural prairies (*Sesleria apennina*)

Azonal vegetation includes non-climatic vegetation and can be classified in the following main types: riparian forests, marsh forests, peat bogs, marshes, lake vegetation, and brackish lagoon vegetation, and coastal (dunes and cliffs) vegetation, human-induced (synanthropic) vegetation.

3. SOCIETY

3.1 Population distribution and density

As of July 2012 the population of Lazio amounts to 5,500,022 inhabitants (ISTAT). Lazio is Italy's third region for population (9.1% of the national total) and density after Lombardy and Campania. About half population live in Rome and about 75% in province of Rome. Compared to other Italian overpopulated regions, Lazio has a relatively low rate of land take soil (Figure 12).

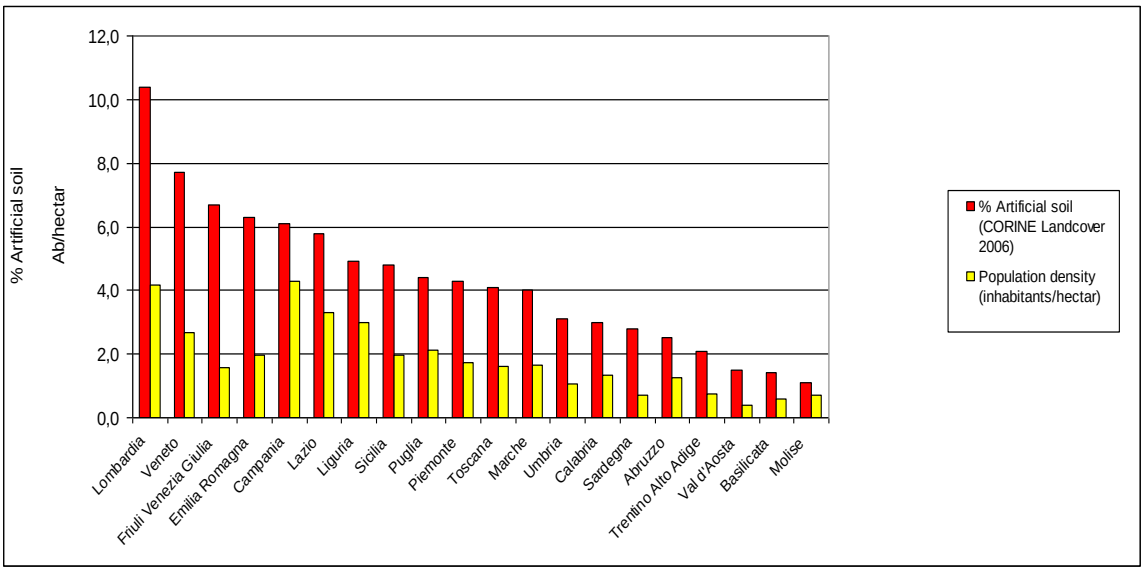

Figure 12. Settlement extent and population density in Italian regions

The regional overall population density is 319 inhabitants per km^2 Table 7). The population density widely ranges from almost 800 inhabitants per km^2 in the highly urbanized province of Rome, with more than 70% of regional population, to 60 inhabitants per km^2 in the mountainous and rural province of Rieti. Average annual variation during the period 2005-2012 is +0.60. As of January 2010, the Italian national institute of statistics (ISTAT) estimated that 497,940 foreign-born immigrants live in Lazio, about 8.8% of the total regional population.

Table 7. Demographic features of Lazio's provinces

Province	*Population*	*Area, km^2*	*Inhabitants km^{-2}*	*% Of total population*
Roma	3,995,250	5,363.30	785	72.6
Latina	544,887	2,256.20	247	9.9
Frosinone	492,302	3,247.10	153	9.0
Viterbo	312,674	3,615.20	89	5.7
Rieti	154,909	2,750.50	58	2.8
Lazio	*5,500,022*	*17,232.29*	*319*	*100.0*

Source: ISTAT, 2012

3.2 Economy

In 2012 gross domestic product (GDP) in Italy was 1,565,916 million (M) Euros (8th in the world). In 2012 economic growth and labour market conditions deteriorated, with growth at -2.3% and unemployment rising to nearly 11%. Italy's GDP is now 7% below its 2007 pre-crisis level.

As in many other western countries Italian economy has strongly shifted from primary and secondary to tertiary activities. Agriculture accounts for 1.9%, industry for 25.2%, and services for 72.9% of the GDP. Lazio's contribution to the GDP of Italy is around 10.1% (whereas its population is 9.1% of the national total). The *per capita* GDP is above the national average and about 13% higher than the EU average. Currently only 4.0% of the labour force (0.924 M) is employed in agriculture, 30.1% in industry and 65.9% in other activities, contributing respectively for 2.4%, 26.7 and 70.9% to GDP. Current level of unemployment rate in the region has reached 10.8%. In the last year the unemployment rate has increased in all provinces of Lazio, reaching levels above the regional average in Viterbo (13.0%), Latina (13.9%) and Frosinone (12.7%).

Lazio is more of a public sector and consumer economy than any other region in the country. Approximately 80% of the working population is employed in the services sector. This is a considerable proportion, but is justified by the presence of the capital, which is the core of public administration, banking, tourism, insurance and other sectors. Lazio has to import many goods from outside the region. Currently in Lazio only 1.8% of the labour force is employed in agriculture, 17.5% in industry and 80.7% in other activities.

Agriculture and forestry are of narrow economic significance and the work in the primary sector often takes the form of a second job. The size of agricultural holdings varies greatly throughout the region (average: 4.5 ha). As an area of transition between climates, the region grows a wide variety of crops (cereals, fodder crops, grapes, olives, fruit and vegetables). Nursery farming for flowers and early vegetables is expanding along the coast (Provinces of Rome and Latina) and around the hill towns to the south of Rome.

The industrial structure (about 17% of the total regional GPD) of the region remains basically weak, especially after the economic turmoil. Industry is unevenly scattered in the region and this factor accentuates intra-regional imbalances. Currently the high-tech industries (optics, telematics, pharmaceuticals, data processing), in goods for final consumption or in industries servicing Rome's political, social, cultural and decision-making functions, for example in publishing, film-making and industrial planning, are facing deep crisis. Tourism remains one of the driving forces of Lazio’s economy.

The distributive trades occupy an important position within the services sector. An analysis of these trades again highlights the dominance of the capital, whose influence in this sector - especially for certain less common services - extends throughout the region and even beyond. The Province of Rome has a good network of big stores but the rest of the region still relies to a great extent on a large number of small retail outlets.

Lazio is equipped with a modern network of motorways, even if still insufficient with respect to the current traffic's volume. The country's main rail routes radiate from Rome. Air services are provided at 'Leonardo da Vinci' and 'Ciampino' airports. The port of Civitavecchia links the mainland with Sardinia.

4. FORESTLAND RESOURCE BASE

4.1 Forest history

Forest vegetation has been present in Lazio since geological eras. In the Mesozoic it was mainly a tropical flora and besides the ongoing development of Angiosperms: This feature was maintained for most of the Tertiary period. The forest structure and composition was comparable with the one present today in tropical, monsoon woodlands. Climate warming which affected the whole Mediterranean basin about six million years ago induced a desert-type vegetation and bounded forests (where taxa such as *Pinus*, *Taxus* and *Ilex* were prevalent) to the mountain areas. The shifting back to a moist climate allowed the spreading of sub-tropical vegetation again, with evergreen forests and savannahs. In the closing phase of the Tertiary period, the Pliocene (about 2-3 millions years ago), vegetation in Italy was very similar, in some respects (evergreen scrub, deciduous forest) to the present one. Later, the climate cooling due to the succeeding ice ages bounded the cold intolerant flora to shelter areas (i.e., Iberian peninsula or the Balkans), from which it could expand again during the interglacial phases, until today.

In Lazio, as if in the rest of Italy, the exploitation of natural resources dates back thousands of years. Since pre-roman times Lazio's forests have been a timber reservoir for different populations. First the Etruscans and later the Romans issued the first forest laws and regulations throughout the country. However, in order to provide adequate timber for naval and building construction, energy purposes and for creating agricultural land, they cleared large forested areas, namely along the river Tiber valley.

After the Roman Empire fall, the barbaric invasions and natural catastrophes created the conditions triggered for land abandonment and massive forest re-colonisation occurred up to year 1000.

The socio-economic standards improved during Renaissance age and forests were cleared again for crops, pastures and urban settlements. A stronger impulse to timber use came from the expansion of overseas commercial activities. Nonetheless the numerous invasions experienced throughout the centuries and the fragmentation of the peninsula in many different states, often governed by foreign families, enhanced the exploitation of forest resources. Only sixty years after the Italian unity (1861) the central government was finally able to conceive a forest policy and the emanation of important laws, still in force today.

Forest exploitation in Lazio was particularly severe during World War II and immediately after. Since the post-war era, forests are steadily and increasing in area extent, mainly due to abandonment of farmland and decline of the agricultural sector.

4.2 Forest types and their distribution

Figure 13 and followings provide a depiction of forest extent and forest types in Lazio. They are based on habitat maps (scale 1:50,000), produced by ISPRA (Casella *et al*. 2008). They make out all the wooded areas bigger than 1 hectare and it's able to discriminate the principal forest types.

The broadleaved deciduous forests dominate (466,387 hectares, or 85.5% of total woodland surface), but Mediterranean forests have a significant incidence too (50,115 hectares, 9.2% of total woodland surface), even although the major agricultural and urban pressures, from coastal to montane belt, on all their potential areal. Coniferous forests (7,010 ha, 1.3% of total woodland surface) are very limited and refer principally to *Pinus nigra* plantations on the Apennine and Antiapennine, and *Pinus pinea* and *Pinus halepensis* plantations on coastal and sub-coastal belt. In presence of low anthropogenic pressure coniferous forests have turned out to be mixed woods after

ingression of nemoral species. At present the ecological value of these mixed woods can be very high and some of them are located within protected areas.

Lazio's forests, according the syntaxonomical classification system, can be grouped within the following main types:

- Mediterranean evergreen forest (Quercetea ilicis) (Figure 13)
- Thermophilous decidous oak woods and other mixed forests (Quercetalia pubescentis-petreae) (Figure 14)
- Montane beech woods and other mesic forests (Fagetalia sylvaticae) (Figure 15)
- Hygrophilous woods (Alnetalia glutinosae, Salicetalia purpureae, Populetalia albae) (Figure 16)

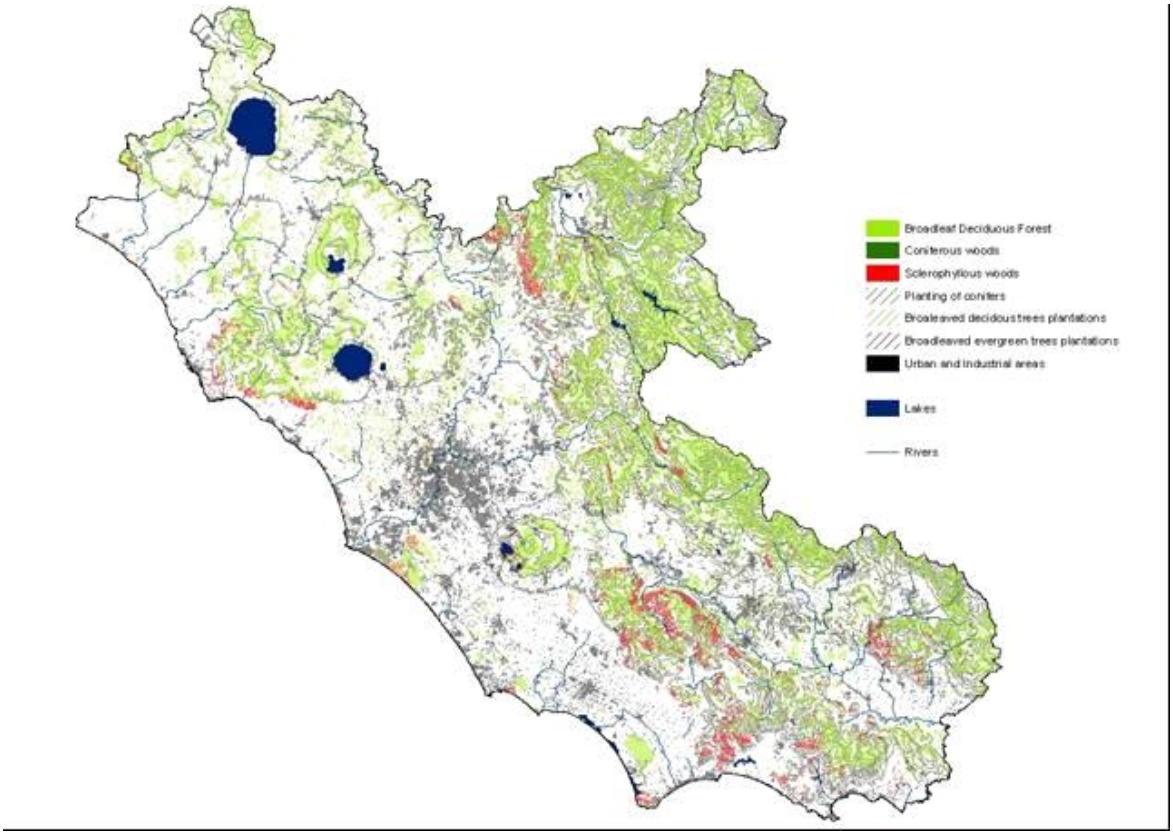

Figure 13. Forest types in Lazio

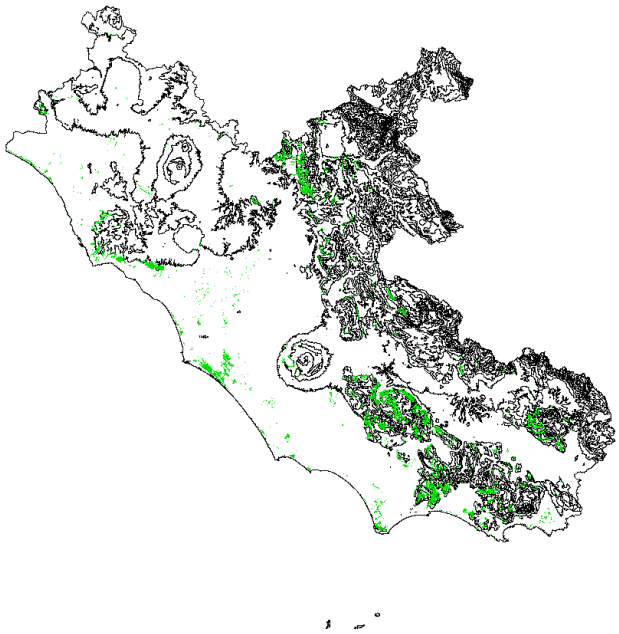

Figure 14. Distribution of *Quercetalia ilicis* forests in Lazio

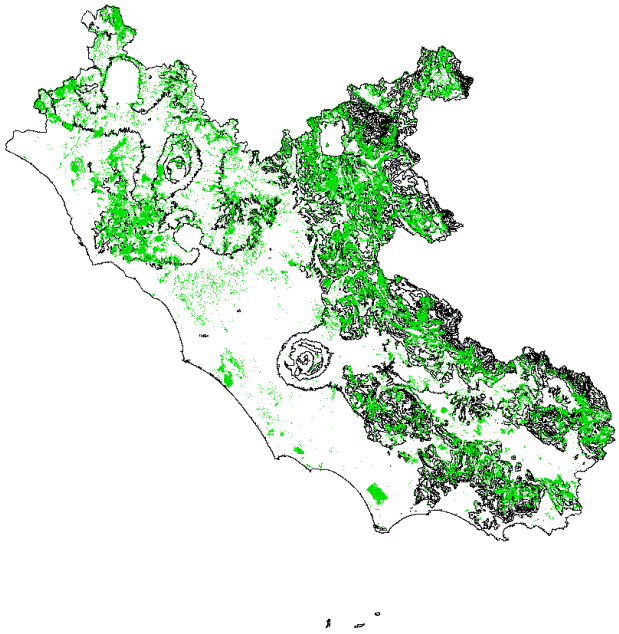

Figure 15. Distribution of *Quercetalia pubescentis-petreae* forests in Lazio

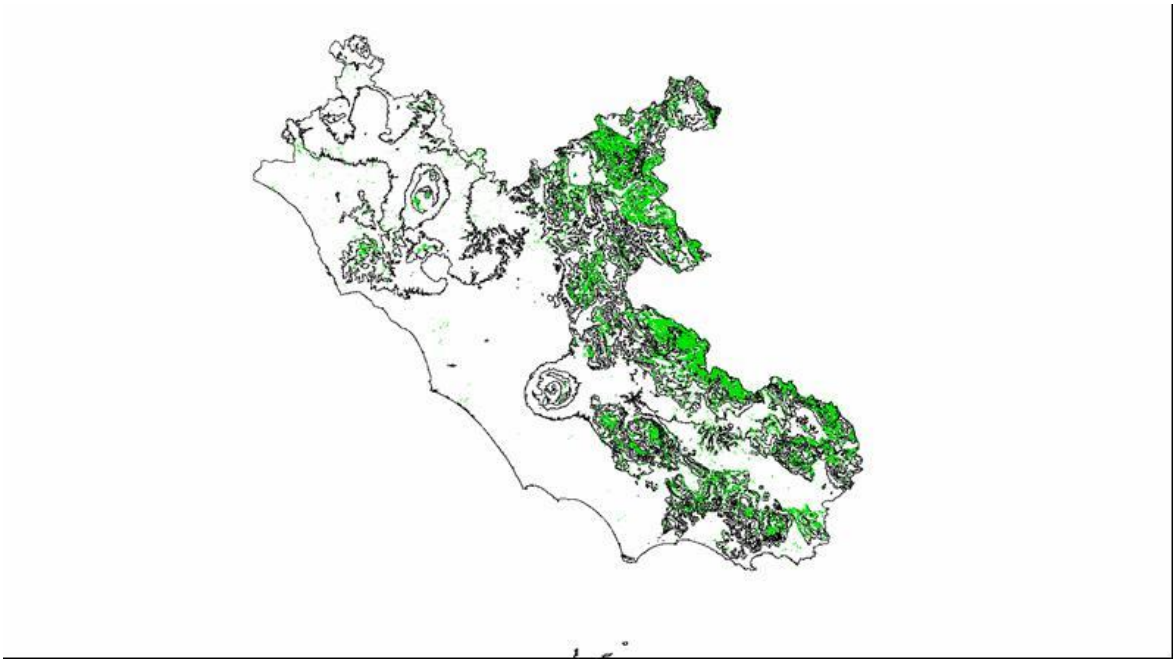

Figure 16. Distribution of *Fagetalia sylvaticae* forests in Lazio

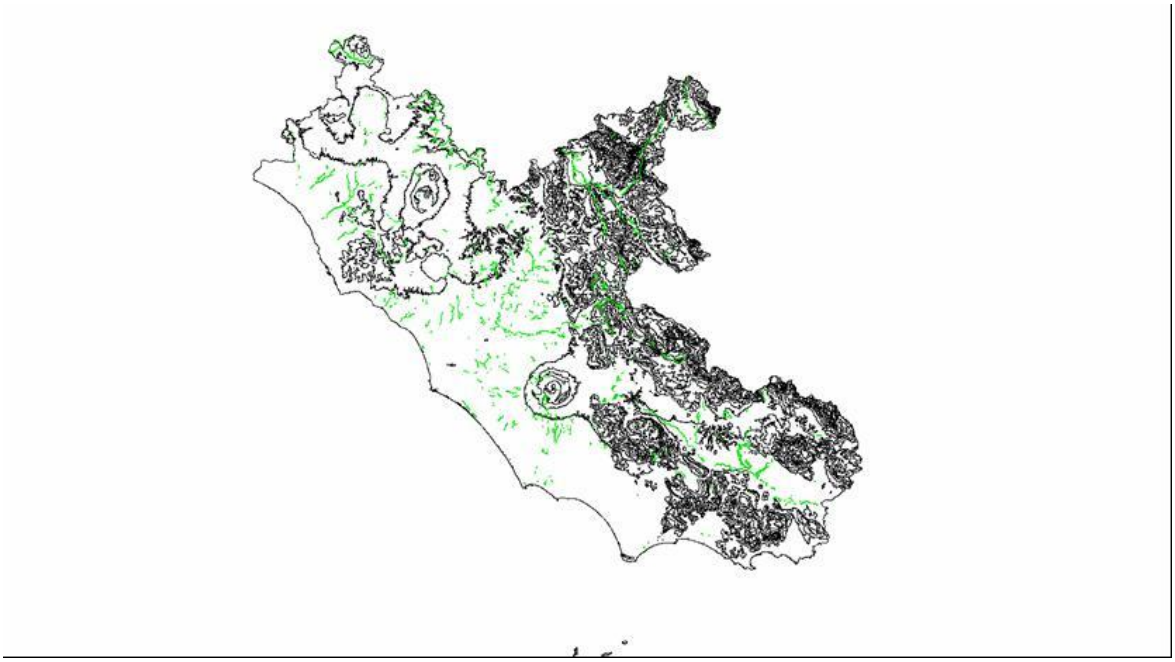

Figure 17. Distribution of *Alnetalia*, *Populetalia* and *Salicetalia* forests in Lazio

Potential vegetation envisages forest distribution from coastal and plain zones up to the higher elevations. However, the actual forest types prevalent in the Mediterranean region are scrub forests, subjected along the history to various kinds of disturbances and degradations (i.e. intensive grazing and fires). Moreover, plain deciduous forests, once abundant, have been cleared a long time ago and replaced by agriculture, industry and heavy urban settlements. Therefore, most of the wooded areas

are left on hills and mountain slopes. In the Apennines open beech woods (*Fagus sylvatica* L.) are the last stands (1,800-2,000 m) before transition to high altitude prairies.

Natural forests (i.e. those unaffected by humans) often contain a diverse range of both tree and shrub species, but virtually all forests in Lazio have experienced strong anthropogenic influences and disturbance throughout the past millennia. Most forests are economically productive to some extent. Nevertheless, about 25% of the forest area is subject to management constraints to secure ecosystem services such as nature conservation, soil protection, water supply, or recreation.

In the hilly belt (0-600 m) the predominant forests are characterized by dominance of oaks (principally *Quercus cerris*, *Quercus pubescens*, *and Quercus frainetto*). On Apennine and Preapennine submontane (600-1200 m) slopes mixed *Fraxinus ornus-Ostrya carpinifolia* forests are frequent. In more detailed form the principal forest types of the region are described in Table 13 and their distribution is shown in Figures 18-28.

Quercus cerris and *Q. frainetto woods*: in Lazio this class includes *Quercus cerris* dominated stands (which is the main forest type in the region, frequent from sub-coastal to mountain belt) and *Quercus frainetto* forests (very rare), occur on sandy soils at low altitude. They comprehensively occupy about 36% of total forest area and almost 11% of total region surface.

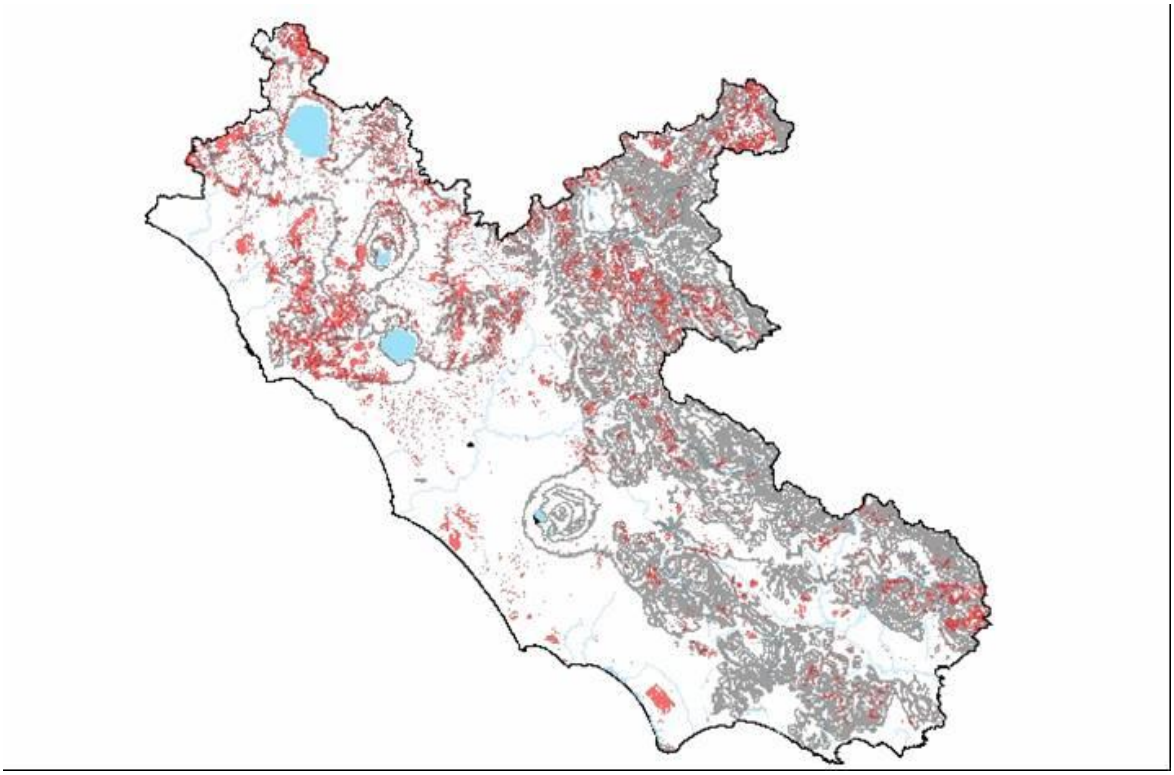

Figure 18. Distribution of *Quercus cerris* and *Quercus frainetto* woods in Lazio

Quercus petraea, *Quercus robur* and *Quercus pubescens* woods: this class include principally *Quercus pubescens* stands, distribuited principally from hilly to sub-montane belt in sub-continental climate areas, and few populations of *Quercus robur*, usually in sub-coastal ad sub-hygrophilous context, as well as *Quercus petraea*, very rare, predominantly founded in northern Lazio. This category occupies 13.8% of total forest surface and almost 4% of total region surface.

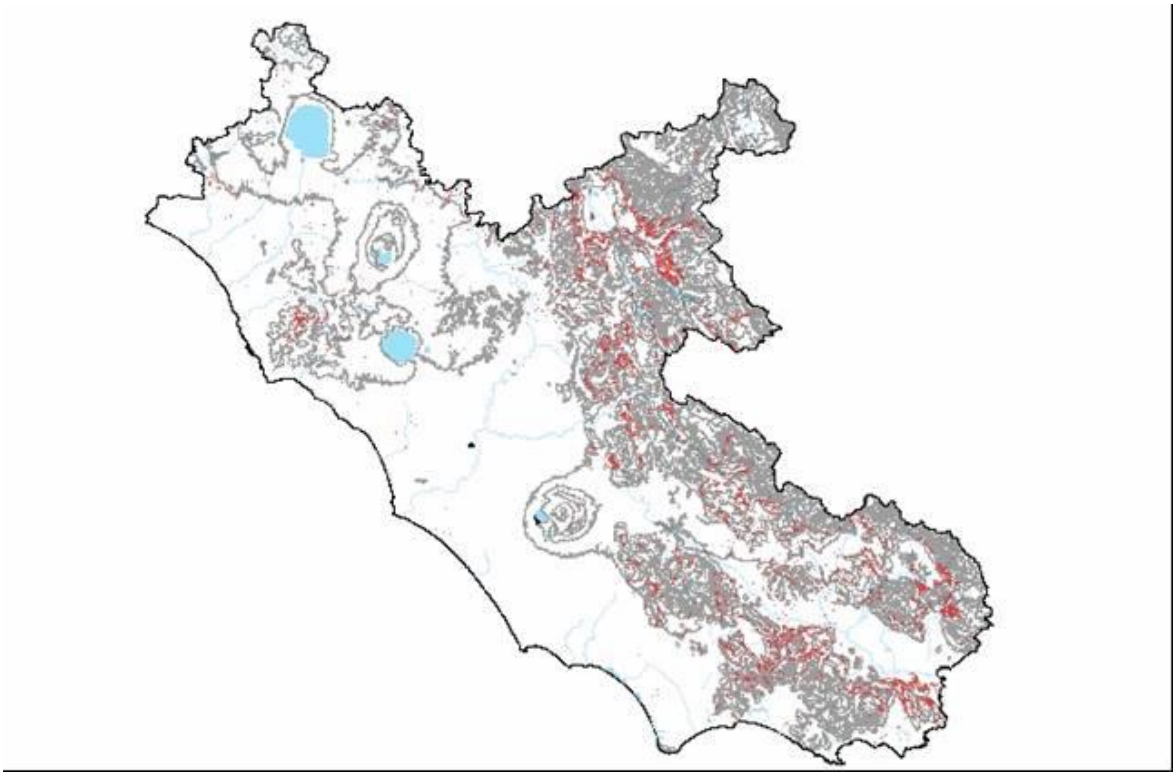

Figure 19. Distribution of *Quercus pubescens*, *Quercus petraea* and *Quercus robur* forests in Lazio

Fagus sylvatica woods: these formations are particularly frequent in montane belt of Preapennine and Apennine but some enclaves with residual meanings are present at lower altitude in Tolfa Mountains and in Sabatini and Cimini vulcanic hills. They occupy about the 15% of forest surface.

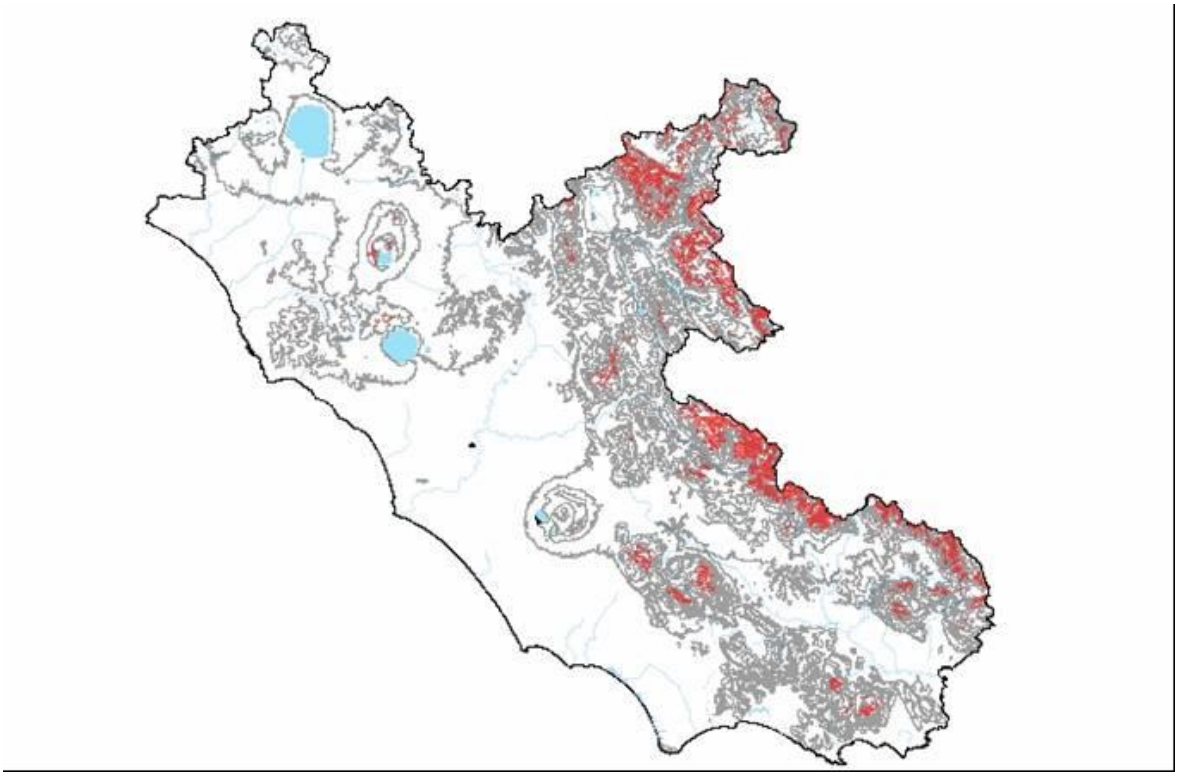

Figure 20. Distribution of *Fagus sylvatica* forests in Lazio

Castanea sativa forests*:* they derived usually by old plantations of chestnut (*Castanea sativa* L.) plantations and are principally developed on vulcanic substrata in Cimini Mountains, in the Province of Viterbo, and Albani hills, in the Province of Rome. Most of chestnut forests are coppiced, although—especially in proximity of conurbation—chestnut orchards are frequent. This category occupies about 9.5% of total forest area.

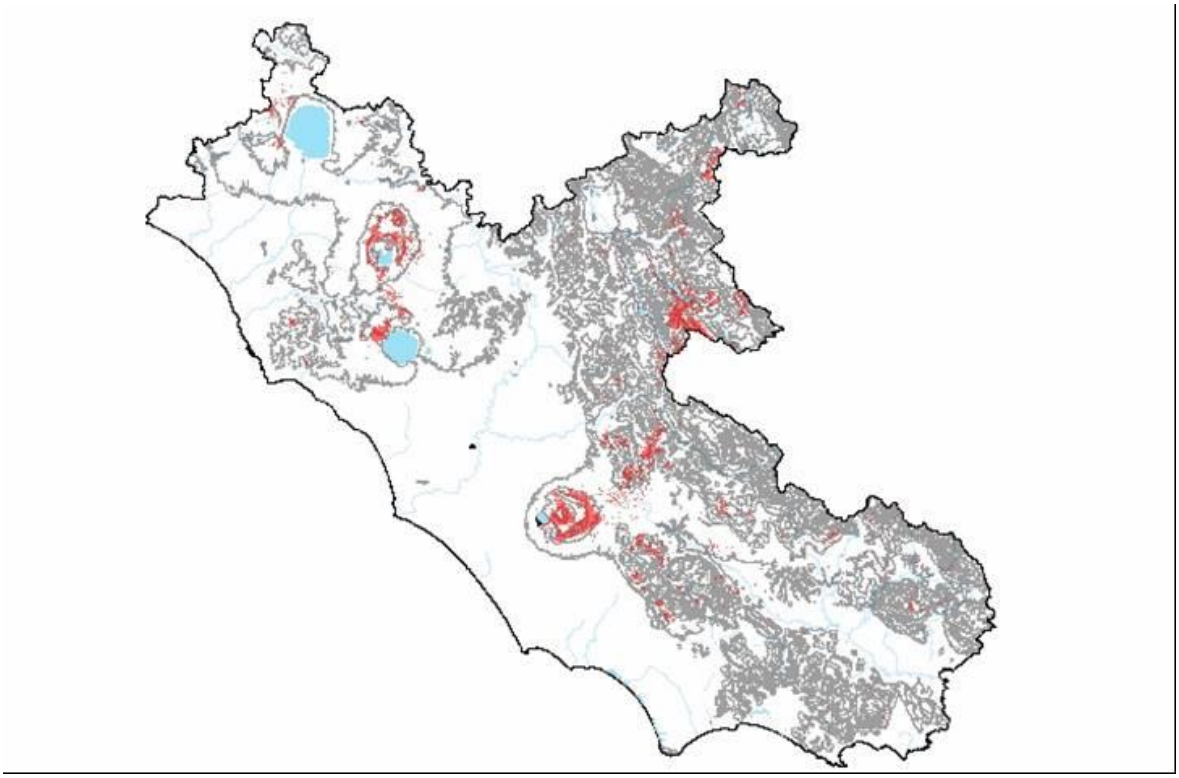

Figure 21. Distribution of *Castanea sativa* forests in Lazio

Ostrya carpinifolia and *Carpinus orientalis* forests: they are typical of Apennine and Subapennine from hilly to mountain belt usually on sharp slopes and poor or stony basic soils. They occupy about 10.2% of total regional forestland.

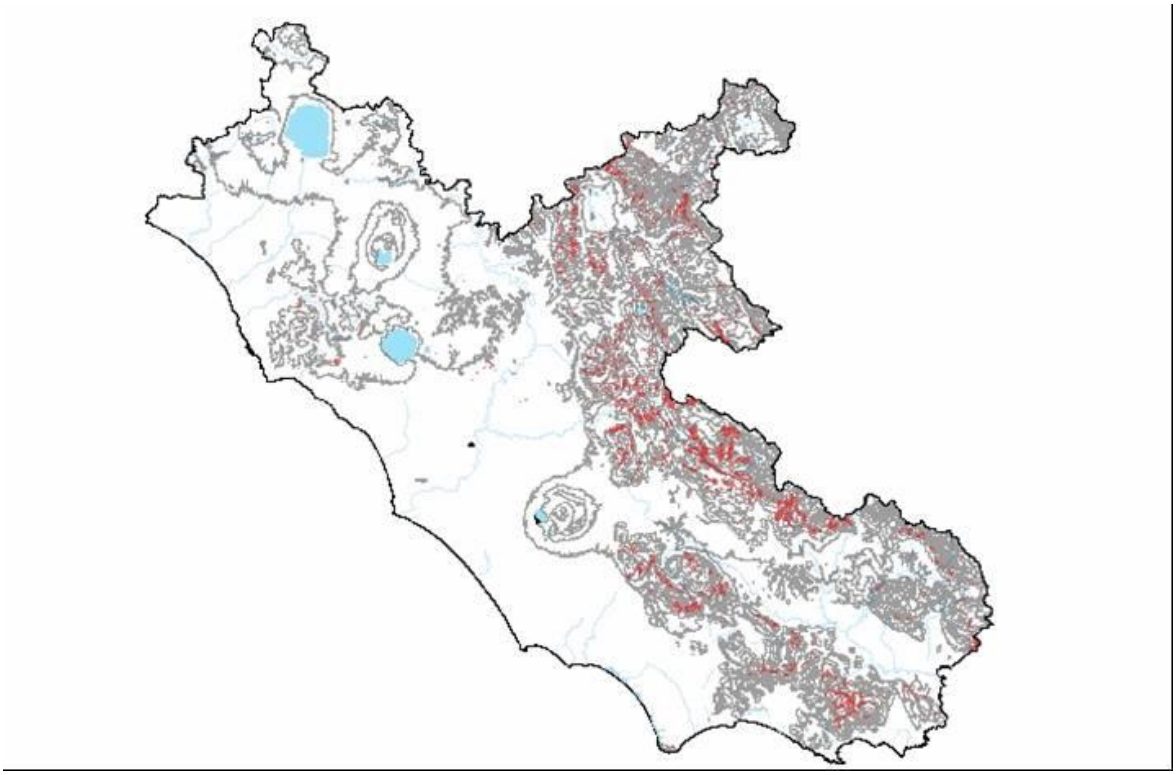

Figure 22. Distribution of *Ostrya carpinifolia* and *Carpinus betulus* forests in Lazio

Hygrophilous forests: The principal species are *Populus nigra*. *Populus canescens*. *Salix alba*, *Salix purpurea* and (rarest) *Alnus glutinosa*. They are developed along the foremost rivers of the region, at low altitude and are often very fragmented and sometimes invaded by *Robinia pseudoacacia*, as a consequence of human or natural disturbances. They are very important as ecological corridors in agricultural zones and occupy almost 1.7% of forest surface.

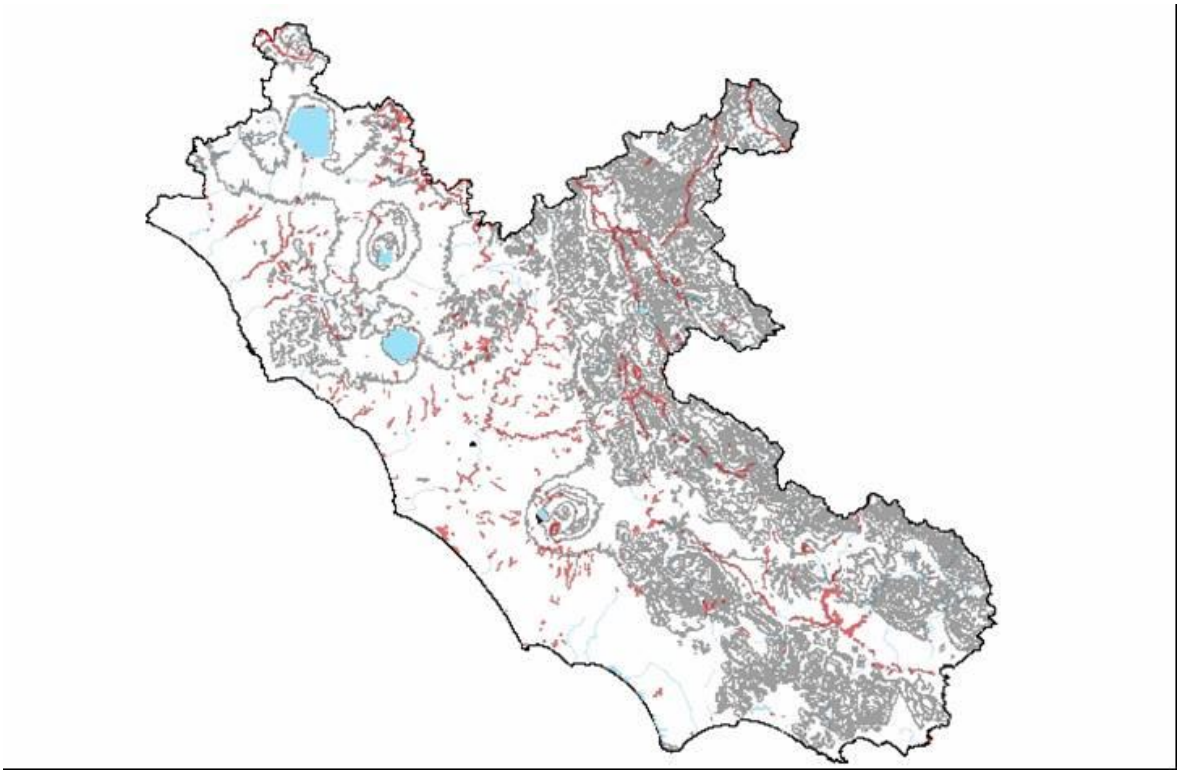

Figure 23. Distribution of hygrophilous forests in Lazio

Other broadleaved forests: In this category are inclued very rare (0.1% of forest surface) *Tilia platyphyllos, Acer pseudoplatanus* and *Acer obtusatus* forests in ravines and gorges.

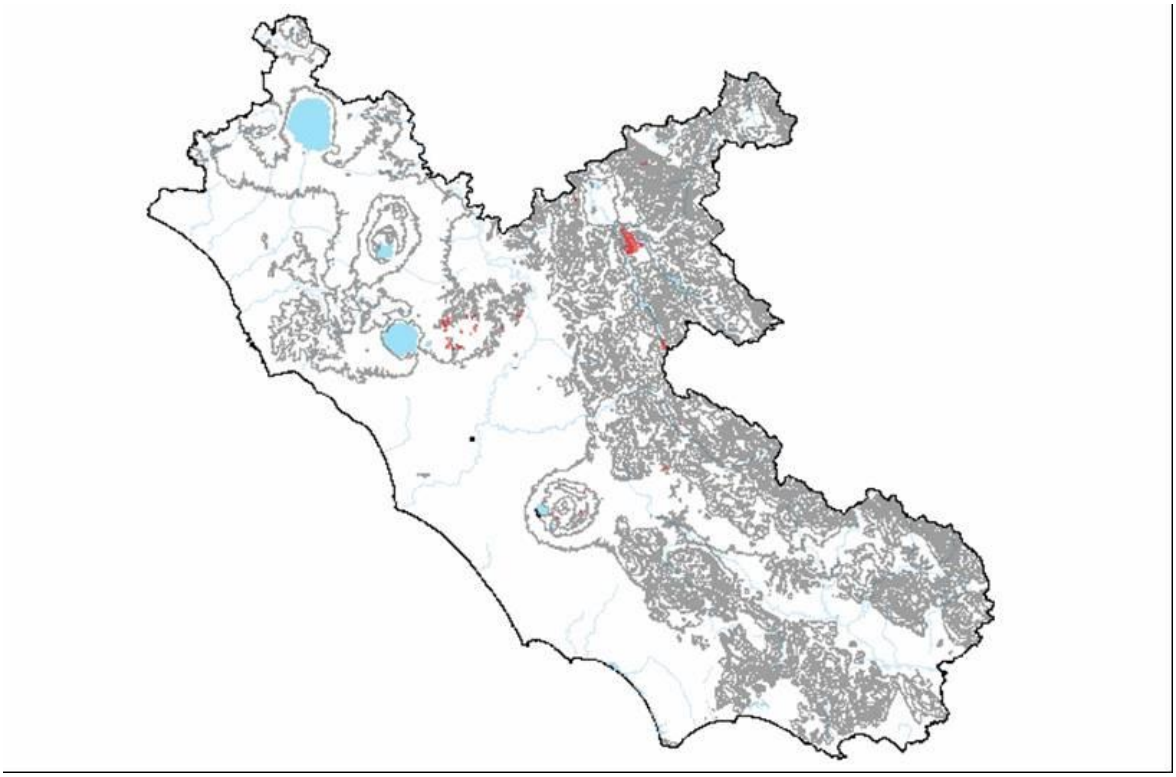

Figure 24. Distribution of *Tilia* spp. and *Acer* spp. forests (included other broadleaved forests) in Lazio

Quercus ilex forests: this tipology is widely distributed as climax vegetation near the coast, in meso-mediterranean climate context, and as extra-zonal vegetation on southern-exposed slopes and poor soils, usually on limestone, up to the mountain belt. It occupies about 6.0% of total Lazio forest land base.

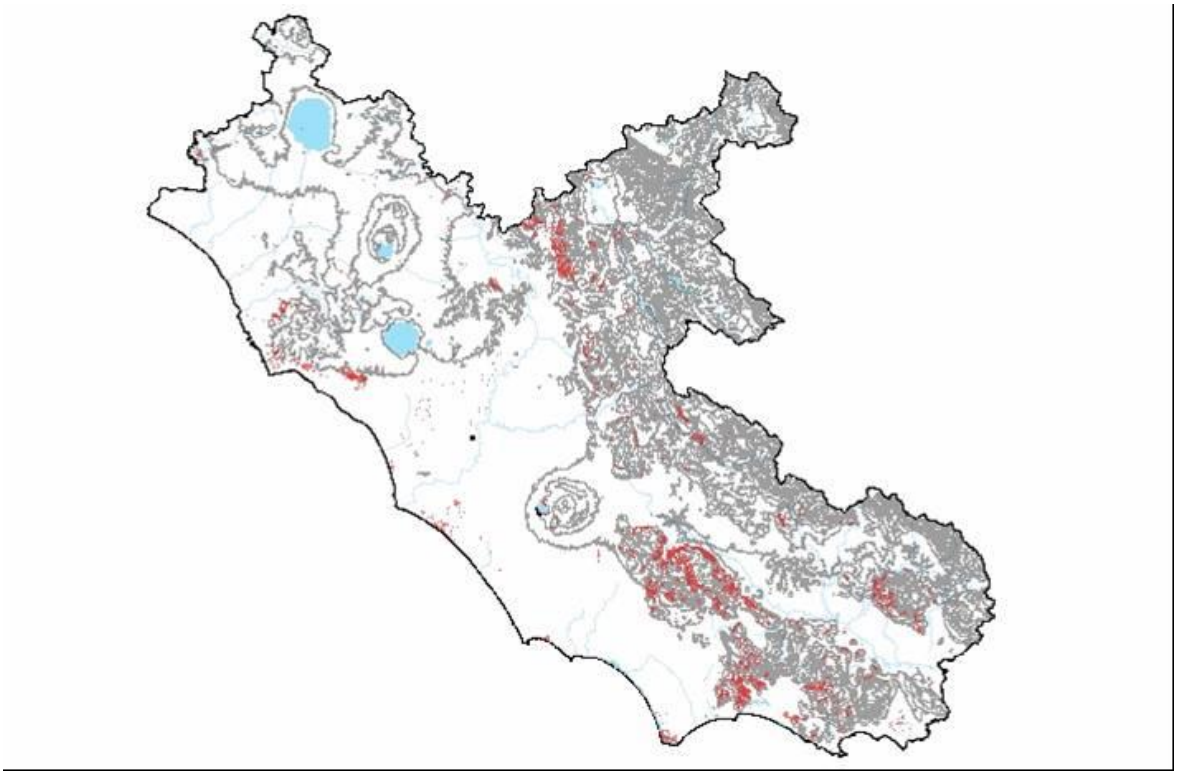

Figure 25. Distribution of *Quercus ilex* forests in Lazio

Quercus suber forests: these formations (0.3% of Lazio's forest surface) are typical of plio-pleistocenic eolic dune systems characterized by acid and siliceous sands. These features are frequent in subcoastal and low hilly belt. In the past they were used for the cork production, but currently most of them are in sub-natural conditions and usually incorporated in protected areas.

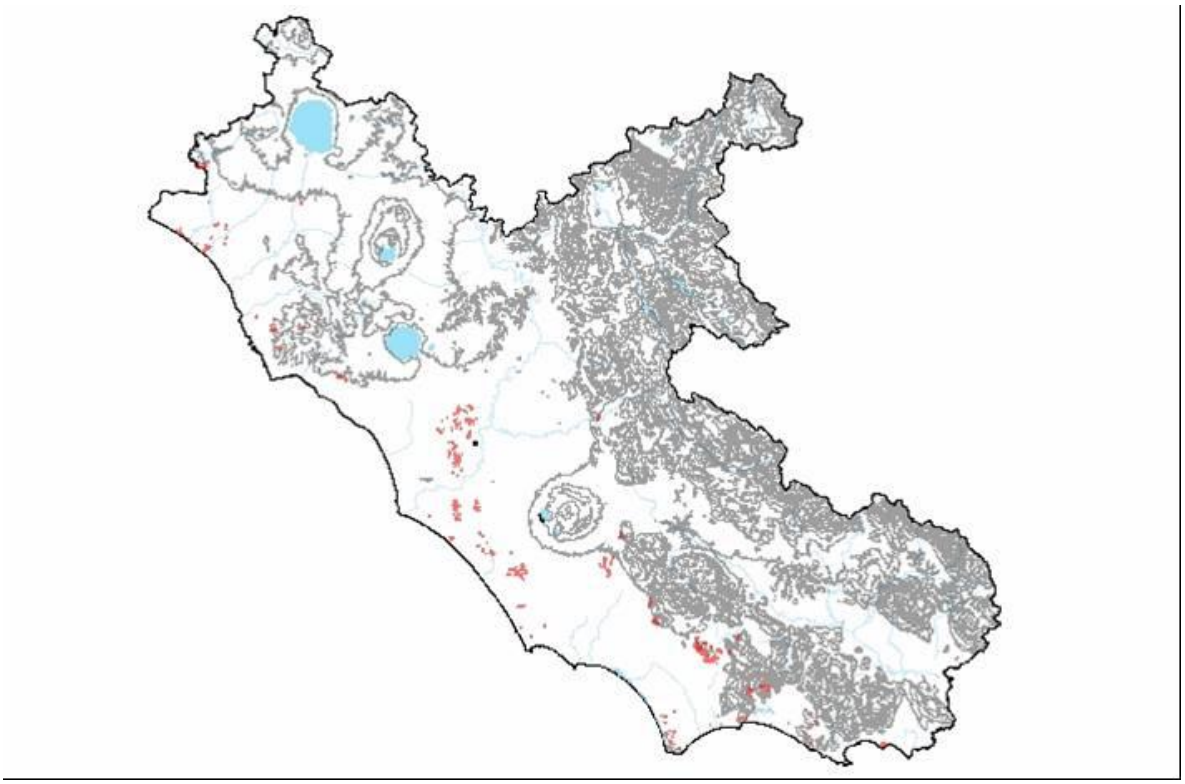

Figure 26. Distribution of *Quercus suber* forests in Lazio

Other evergreen broadleaved forest: In these category Eucaliptus plantations, stretched along the coast, normally in drained lands, are included. They occupy less than 0.2% of Lazio forest land.

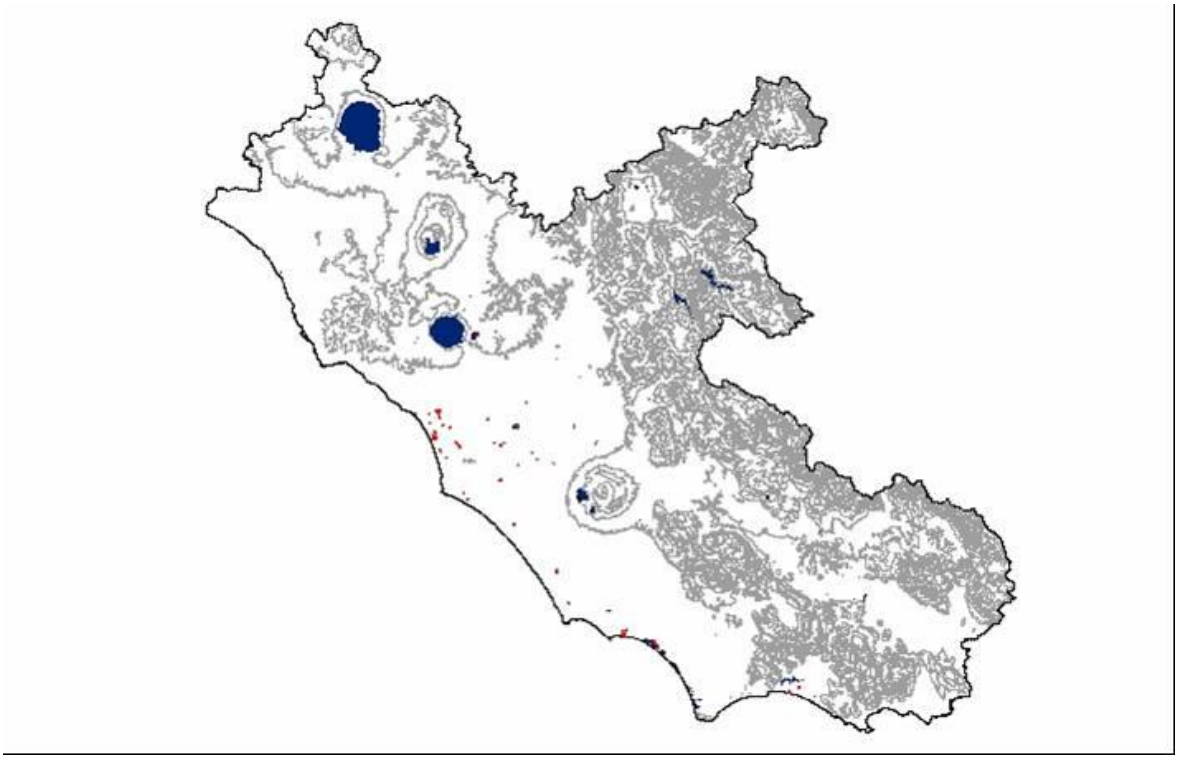

Figure 27. Distribution of "Other Broadleaved evergreen forest" in Lazio corresponding to Eucaliptus spp. plantations.

Pinus nigra forests: all the stands of *Pinus nigra* correspond to old reforestation and occupy about 2.17% of Lazio forests. Sometimes, especially on limestone in mountain belt, *Pinus nigra* shows a big capacity of regeneration, but usually this kind of tipology evolves in mixed stand with broadleaved species: *Ostrya carpinifolia*. *Fagus sylvatica, Fraxinus ornus*, *Quercus pubescens,* and—in hottest sites—Q*uercus ilex*.

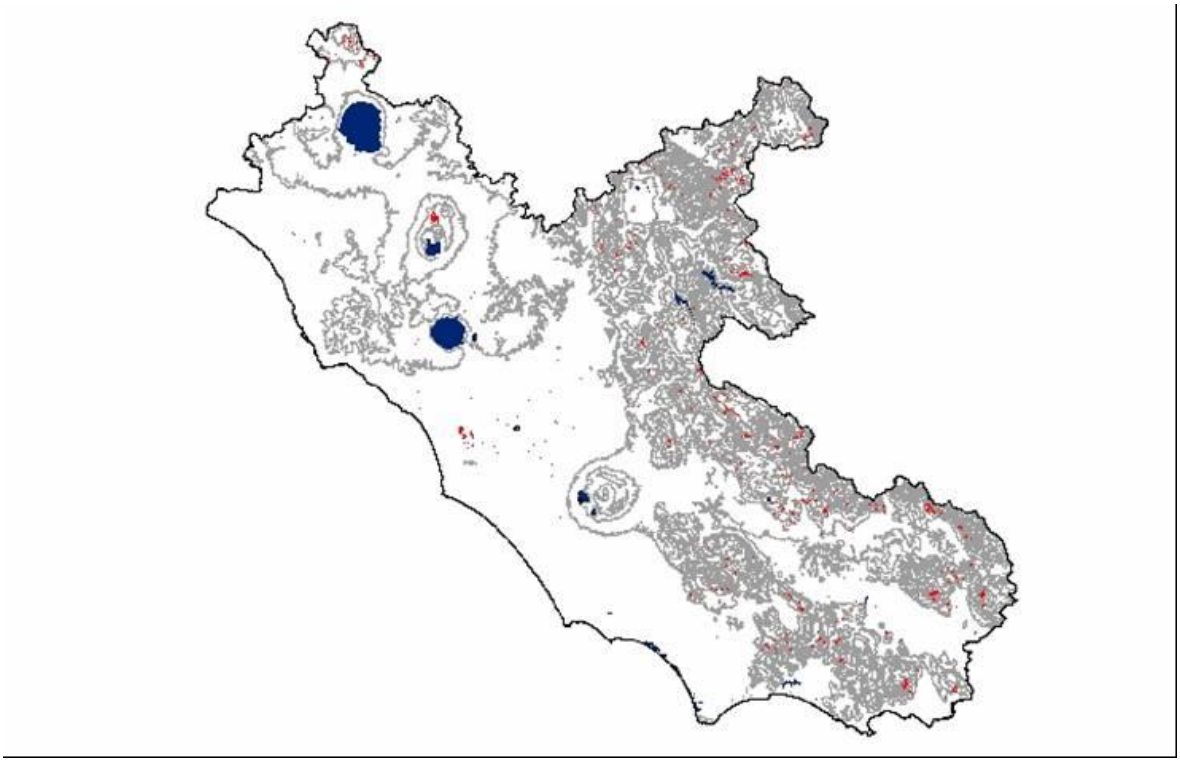

Figure 28. Distribution of *Pinus nigra* forests in Lazio

Mediterranean *Pinus* forests: in Lazio the principal Mediterranean pine species are *Pinus pinea* and *Pinus halepensis*. The forest stands dominated by these species represent aged planted forests, usually nearby the sea. Often, aged pine specimens dominate pre-wood formation with *Quercus ilex* and Mediterranean maquis.

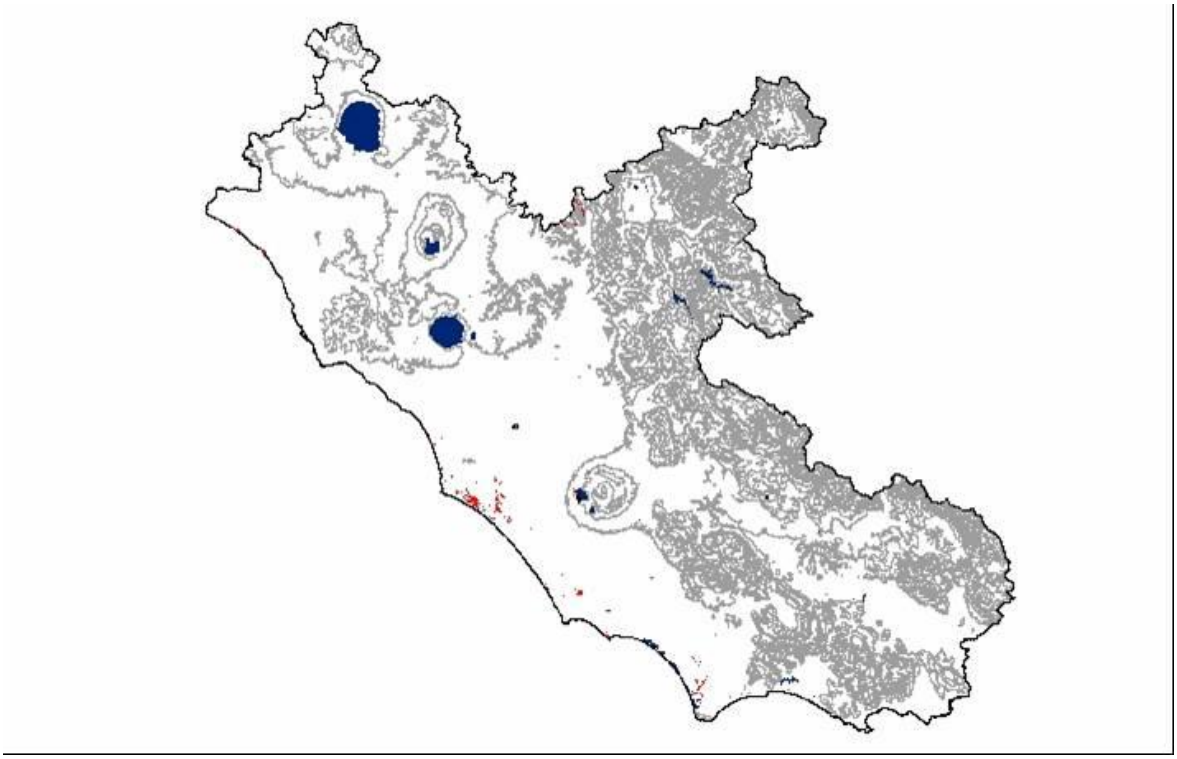

Figure 29. Distribution of Mediterranean pine forests in Lazio

Picea abies forests: this category includes only same small planted stands (0.3% of forest in Lazio). At the level of cartographic discrimination, all stands result less than 1 ha and were included in sorrounding forestal type.

Abies alba: usually Abies alba stands are less than 1 ha and are mixed with Fagus sylvatica woodlands.

4.3 Forest resources: extension and main species

The main source of information on the forest cover structure and distribution available in Italy is represented by the Italian Inventory of Forest and Carbon, carried out in 2005, that adopted—inter alia—a broad definition of forest land, including land covered by shrubs and scattered trees.

FOREST RESOURCES IN ITALY Main facts and figures

Making reference to more detailed source of information, forests in Italy extend over 8,675,100 ha, corresponding to 29% of the total land area (http://www.sian.it/inventarioforestale/). High forests make about 25% of this surface, coppices more than 40%. The remaining 35% are both “specialised production forests” (i.e... plantations for timber or wood paste production, tree farming, or non timber woods: cork oak. chestnuts. etc.) and "other forests", such as shrubs. Maquis, rocky or riparian woods, all rarely managed.

In Italy's high forests conifers are dominant, both for extension (56.3%) and timber volume (63.1%). The most important species is Norway spruce (*Picea abies* Karst); mountain Pines (*Pinus sylvestris* L., *Pinus nigra* Arnold. *P. laricio* Poiret) and European larch (*Larix decidua* Mill.) are well widespread. Most coniferous forests are located in the Alps (montane and subalpine spruce. fir, and larch forests), but some significant ones can be found also in the Southern Apennines (*Pinus laricio* Poiret). Broadleaved high forests are predominantly beech woods (*Fagus sylvatica* L.) and oak woods (especially *Quercus cerris* L.).

Most species are native or autochthonous. The few exotic ones are generally used for industrial forestry. Among coppices, chestnut (*Castanea sativa* Miller), hornbeam (*Carpinus betulus* L. and *Ostrya carpinifolia* Scopoli) and oaks (*Quercus* spp.), often in mixed composition, are the most prevailing species in hilly zones. In montane zone, beech (*Fagus sylvatica* L.) is the most important species, both on the Alps and on the Apennines (Table 13-14).

Since the end of 1st World War (1919), the Italian forest area is gradually and relentlessly expanding. This is because primarily of natural colonisation of abandoned agricultural lands, grazelands, pastures and rangelands (as a consequence of a clear commitment made by the European Community and the national and regional governments to reduce the price protection policy for many agricultural products) to shrublands and forests; and secondly to afforestation and reforestation programmes.

According to the INFC (2008) total forestland in Lazio is approximately 605,859 ha, about 35.2% of the region's total land area (1,720,768 ha). About 89.8% (543,884 ha) is classified as 'wooded land' and 10.2% (61,974 ha) of the forestland is classified as 'other wooded land' (OWL) (Table 11).

Table 11. Forest land in Lazio by different forest types

Forest type		Area, ha	% to the forest type	% to the total
1. Wooded land	Coppice (without standards)	46,425	13.6	7.7
	Coppice with standards	262,176	77.0	43.3
	Simple coppice	32,056	9.4	5.3
	Total coppice	*340,657*	*100.0*	*56.2*
	In-transition high forests	12,527	12.9	2.1
	Even-aged high forests	31,687	32.6	5.2
	Uneven-aged high forests	41,333	42.5	6.8
	Irregular high forests	11,791	12.1	1.9
	Total High forest	*97,338*	*100.0*	*16.1*
	*Special forest (*Castanea sativa, Juglans regia, Quercus suber*)*	*4,053*	*100.0*	*0.7*
	Undefined	*28,003*	*100.0*	*4.6*
	Areas not classified for a forest type category	*73,834*	*13.6*	*12.2*

	Total	**543,885**	**100.0**	**89.8**
2. Other wooded land, OWL	*Areas not classified for a forest type category*	*61,974*	*100.0*	*10.2*
	Total	**61,974**	**100.0**	**10.2**
Total (1+2)		***605,859***	***100.0***	***100.0***

Source: INFC 2008

The INFC data report the extent of 'tall forests' (*boschi alti*, according to the classification adopted by the INFC), planted forests and forest areas temporarily unstocked, under the same 'forest' macro-category.

Quercus cerris, *Q. frainetto* and *Q. troiana* forests are the most prevailing forest type (122,900 ha, 23.0% of total tall forests), followed by *Ostrya* spp. and *Carpinus* spp. forests (96,167 ha), *Quercus petraea*, *Q. robur* and *Q. pubescens* forests (79,816 ha) and *Fagus sylvatica* forests (71,710 ha). *Castanea sativa* forests (35,003 ha) are still significant in terms of extent, as well as *Quercus ilex* forests (47,899 ha) and *Quercus suber* forests (2,211 ha). 'Tall forests' include the remaining area of 'forest' macro-category not falling in the previous groups.

According to the INFC classification, planted forests are distinguished from high forests (*fustaie*) because of the artificial origin, the presence of a specific planting layout, and the running of typically agronomic practices (INFC 2008). Planted forests cover about 1,705 ha (about 0.3% of total forests). Most planted forests are 'other broadleaved planted forests' (1,336 ha), while *Populus* spp. planted forests cover 369 ha. Forests areas temporarily unstocked take in those forest areas temporarily without tree cover—due to natural or anthropogenic causes—for which forest restoration is foreseen in a relatively short period of time and cover 7282 ha, 1.3% of total forests.

Table 12. Forests in Lazio: extent by different (dominant species) forest types

	Area, ha
Picea abies forests	369
Pine forests (*P. nigra, P. laricio, P. loricatus)*	8,474
Mediterranean pine forests	7,344
Other coniferous forests, pure or mixed	1,474
Fagus sylvatica forests	71,710
Quercus petraea, *Q. robur* and *Q. pubescens* forests	79,816
Quercus cerris, *Q. frainetto* and *Q. troiana* forests	122,900
Castanea sativa forests	35,003
Ostrya spp. and *Carpinus* spp. forests	96,167
Hygrophilus forests	9211
Other deciduous broadleaved forests	49,741
Quercus ilex forests	47,899
Quercus suber forests	2,211
Evergreen deciduous forests	2,579
A. Tall forests	**534,898**
Poplar planted forests	369
Other broadleaved planted forests	1,336
Coniferous planted forests	0

B.	**Planted forests**	**1,705**
C.	**Forests temporarely unstocked**	**7,282**
Total forests (A+B+C)		**543,885**

Since the latest decades the region's forestland is gradually expanding. This trend is not only due to new forest planting activities, but also to an increasing and continuous natural re-colonisation of abandoned farmland and pastures. The difficulty in monitoring this phenomenon may explain the apparent contrast between the official ISTAT (National Institute of Statistics) data sources and other sources, in particular the INFC and the most recent survey CORINE land cover (ISPRA 2006).

4.4 Standing volume, growing stock, and growth

The estimates and forecasts of the bioenergy potential of a forest may be derived through assessing how much standing volume there is in the forest, how quickly the forest is growing (and gaining standing volume/increment) and when and how much of this growth in standing volume will be harvested. This is achieved firstly by estimating three key elements of the forest as it stands: the area of woodland, the type of woodland and its rate of growth. The annual gain in standing volume is known as the increment (see box below).

Defining standing volume and increment

The standing volume of trees refers to the volume of standing trees, living or dead, above-stump measured overbark to top (0 cm). Standing volume includes all trees with diameter over 0 cm diameter breast height (d.b.h. -- typically at 130 cm above stump). It includes: tops of stems, large branches, dead trees lying on the ground which can still be used for fibre or fuel; it excludes: small branches, twigs and foliage. (UNECE/FAO (2000). According to the current international definition, *growing stock* refers to: "The living tree component of the standing volume. Volume is intended over bark of all living trees more than X cm in diameter at breast height (d.b.h.), or above buttress if higher. It includes the stem from ground level or stump height up to a top diameter of Y cm, and may also include branches to a minimum diameter of W cm. Countries must indicate the three thresholds (X, Y, W cm) and the parts of the tree that are not included in the volume (FAO 1998, UNECE FAO 2000, Tomppo *et al*. 2010). By convention, the volume of dead trees is not included. Growing stock volume is the main measure used in reporting of estimates of growing stock. Ideally growing stock estimates are based directly on national inventory assessments taken for an appropriate base year. Growing stock volume is usually the measure from which estimates of increment are derived.

Growing stock forecasts, in conjunction with removals and increment forecasts are a strategic measure of the sustainability of intended forest management. Forecasts of growing stock volume are needed as a component in the calculation of standing biomass and carbon.

Gross increment is the average annual volume of increment (an increase of growing stock) that over the reference period of all trees is measured by a minimum diameter breast height (d.b.h.) of 0 cm. It includes the increment of trees that have been felled or have died during the reference period. This increment is usually measured every 5 or 10 (although rarely) years and this annual increment becomes the average for that reference period.

Net annual increment is the average annual volume over the given reference period of gross increment but less than that of natural losses of all trees to a minimum diameter of 0 cm (d.b.h) (FAO 2000). In order to monitor the annual production and sustainability in forestry, one also has to be aware of three other terms related to fellings and other losses in forests. Annual fellings refer to the average annual standing volume of all trees that are felled during a given period. It includes the volume of trees or parts of trees that are not removed from the forest. It also includes silvicultural and pre-commercial thinning. These fellings are further divided into removals and logging residues.

Removals represent those parts of fellings that are transported out of the forest. Logging residues are represented by that part of felled stem wood, which remain in the forest. Together fellings and natural losses constitute the drain, meaning all wood material that has died from natural causes (natural loss) or has been taken by people from the growing stock.

The data source for standing volume and increment is the National Inventory for Forests and Carbon (2008). According to it, the national standing volume of high forests is about 405 millions of m^3 (about 211 m^3 ha^{-1}), with a total annual increment of 15,127,900 m^3 (on average, 7.9 m^3 ha^{-1} yr^{-1}). Considering only the trees with d.b.h. >17.5 cm the total growing stock lowers down to 341 millions of m^3 and the current annual increment is 5.1 m^3 ha^{-1} yr^{-1}. Among spontaneous species, Norway spruce and European beech have the greatest net annual increment (NAI): 9.4 m^3 ha^{-1} yr^{-1} and 8.5 m^3 ha^{-1} yr^{-1} respectively.

At present, the annual yield in high forests rarely exceeds 50% of the annual growth and harvesting, on average, is 35% of the current increment. This led contributes to a general increase of the growing stocks in the last decades.

Standing volume and current increment of forests in Lazio are reported respectively in tables 13 and 14, distribute by main species and management types. In Lazio wooded areas produces a current increment of 1,548,090 m^3 per year (average net increment of 2.9 m^3 yr^{-1}). About 70.8% of the current increment is produced by coppices, about 23.8% by high-forests.

Table 13. Forests in Lazio: total and area unit standing volume by management type and species												
Forest category	**Coppice**		**High Forest**		**Special cultural type**		**Undefined cultural type**		**Unclassified cultural type**		**Total**	
	Total standing volume (m^3)	Standing volume per hectare (m^3 ha^{-1})	Total standing volume (m^3)	Standing volume per hectare (m^3 ha^{-1})	Total standing volume (m^3)	Standing volume per hectare (m^3 ha^{-1})	Total standing volume (m^3)	Standing volume per hectare (m^3 ha^{-1})	Total standing volume (m^3)	Standing volume per hectare (m^3 ha^{-1})	Total standing volume (m^3)	Standing volume per hectare (m^3 ha^{-1})
Picea abies forests	0	0	40,863	110.0	0	0	0	0	0	0	40,863	110.0
Pine forest (*P. nigra. P. laricio. P. loricatus)* forests	0	0	1550,386	200.4	0	0	0	0	0	0	1550,386	200.4
Mediterranean pine forests	0	0	1,282,012	194.0	0	0	0	0	0	0	1,282,012	194.0
Other coniferous forests, pure or mixed	0	0	516,942	350.8	0	0	0	0	0	0	516,942	350.8
Fagus sylvatica forests	6,366,964	192.0	11,368,810	352.1	0	0	0	0	0	0	17,735,774	247.3
Quercus petraea. *Q. pubescens* and *Q. robur* forests	2,836,674	55.1	1,031,035	82.3	0	0	417,806	75.6	0	0	4,285,515	53.7
Quercus cerris and *Q. frainetto* forests	8,099,652	88.7	4,173,330	219.4	0	0	0	0	0	0	12,272,983	99.9
Castanea sativa forests	4,747,142	174.1	565,930	384.0	406,049	110.2	0	0	0	0	5,719,120	163.4

Ostya and *Carpinus* forests	6,026,550	75.0	223,645	67.4	0	0	37,293	33.7	0	0	6,287,488	65.4
Hygrophilous forests	286,602	194.5	417,193	125.8	0	0	186,612	126.6	0	0	890,407	96.7
Other deciduous broadleaved forests	1,560,165	83.0	569,146	90.9	0	0	898,873	56.7	0	0	3,028,184	60.9
Quercus ilex forest	3,220,154	91.0	0	0	0	0	0	0	0	0	3,220,154	91.0
Quercus suber forests	197,478	109.3	19,509	27.0	336.274	93.1	0	0	0	0	553,261	90.1
Evergreen broadleaved forests	19,262	17.4	0	0	0	0	87,253	78.9	0	0	106,515	41.3
Total tall forests	**33,180,999**	**97.4**	**21,990,980**	**225.9**	**449,785**	**111.0**	**1,627,837**	**58.1**	**0**	**0**	**57,249,600**	**107.0**
Poplar plantations	0	0	0	0	0	0	0	0	107,123	290.7	107,123	290.7
Other broadleaved planted forests	0	0	0	0	0	0	0	0	73,360	54.9	73,360	54.9
Coniferous planted forests	0	0	0	0	0	0	0	0	0	0	0	0
Total Planted forests	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**180,483**	**105.9**	**180,483**	**105.9**
Forest areas temporarily un-stocked	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**80,552**	**11.1**	**80,552**	**11.1**
Total forests	**33,180,999**	**97.4**	**21,990,980**	**225.9**	**449,785**	**111.0**	**1,627,837**	**58.1**	**261,036**	**3.5**	**57,510,635**	**105.7**

Table 14. Forests in Lazio: current increment by management type and species												
Forest category	**Coppice**		**High Forest**		**Special cultural type**		**Undefined cultural type**		**Unclassified cultural type**		**Total**	
	Total Current Annual Increment (m^3)	Current Annual Increment per hectare (m^3 ha^{-1})	Total Current Annual Increment (m^3)	Current Annual Increment per hectare (m^3 ha^{-1})	Total Current Annual Increment (m^3)	Current Annual Increment per hectare (m^3 ha^{-1})	Total Current Annual Increment (m^3)	Current Annual Increment per hectare (m^3 ha^{-1})	Total Current Annual Increment (m^3)	Current Annual Increment per hectare (m^3 ha^{-1})	Total Current Annual Increment (m^3)	Current Annual Increment per hectare (m^3 ha^{-1})
Picea abies forests	0	0	7,437	20.2	0	0	0	0	0	0	7,437	20.2
Pine forest (*P. nigra. P. laricio. P. loricatus)* forests	0	0	46,693	6.0	0	0	0	0	0	0	46,693	6.0
Mediterranean pine forests	0	0	24,576	3.7	0	0	0	0	0	0	24,576	3.7
Other coniferous forests, pure or mixed	0	0	12,213	8.3	0	0	0	0	0	0	12213	8.3
Fagus sylvatica forests	113,897	3.4	133,972	4.1	0	0	0	0	0	0	247,869	3.5
Quercus petraea. *Q. pubescens* and *Q. robur* forests	79,218	1.5	24,190	1.9	0	0	12,511	2.3	0	0	115,919	1.5
Quercus cerris and *Q. frainetto*	286,246	3.1	87,985	4.6	0	0	0	0	0	0	374,231	3.1

forests												
Castanea sativa forests	220,566	8.1	1,825	1.2	6,821	1.9	0	0	0	0	229,212	6.6
Ostya and *Carpinus* forests	202,000	2.5	4,430	1.3	0	0	1,974	1.8	0	0	208,404	2.2
Hygrophilous forests	11,947	8.1	10,240	3.1	0	0	7,912	5.4	0	0	30,099	3.3
Other deciduous broadleaved forests	90,800	4.8	12,688	2.0	0	0	30,302	1.9	0	0	133,790	2.7
Quercus ilex forest	89,733	2.5	0	0	0	0	0	0	0	0	89,733	1.9
Quercus suber forests	498	1.4	2,963	2.0	1138	3.1	0	0	0	0	4,599	4.4
Evergreen broadleaved forests	1116	1.0	0	0	0	0	1,784	1.6	0	0	2,900	1.1
Total tall forests	**1,096,021**	**3.2**	**369,212**	**3.8**	**7,959**	**2.0**	**54,483**	**1.9**	**0**	**0**	**1,527,675**	**2.9**
Poplar plantations	0	0	0	0	0	0	0	0	9,448	25.6	9,448	25.6
Other broadleaved planted forests	0	0	0	0	0	0	0	0	8,009	6.0	8,009	6.0
Coniferous planted forests	0	0	0	0	0	0	0	0	0	0	0	0
Total Planted forests	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**17,457**	**10.3**	**17,457**	**10.3**

Forest areas temporarily un-stocked	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,958**	**0.4**	**2,958**	**0.4**
Total forests	**1,096,021**	**3.2**	**369,212**	**3.8**	**7,959**	**2.0**	**54,483**	**1.9**	**37,872**		**1,548,090**	**2.9**

4.5 Protected areas

In Lazio there are 3 National Parks, 10 Regional Parks, 183 Sites of Community Importance (SCI) and 43 Special Areas of Conservation (SAC). In total the Region's protected area is about 424,000 ha; woodlands in protected area represent 50.8% of protected areas (about 215,478) and 39.6% of total woodland (Figure 30).

Within the sites of community importance (SCI) and special sreas of conservation (SAC) were identified 14 forest habitat types according tipology proposed by EU Manual (ARP 2008). They are much diversified in relation to litological, climatic, edaphic and phytogeographic diversity, but the predominant structure is coppicing, in particular at low altitude, where high forest stands are extremely rare.

Conventional silviculture operations in protected areas of Lazio have not always given the due priorities to the objectives of conservation and natural improvement of the forest resources. Approaches to silvicultural management vary quite significantly depending on many factors. In some cases most of the forests are left to free dynamics and successional stages or at least treated by natural criteria in cutting, thus obtaining significant improvements in population structure and biodiversity; in other cases, no particular conservation measures have been adopted, and thus currently there is no substantial differentiation in terms of utilisation between forests inside and forest outside protected areas. Of particular importance is the possibility of and need to create A Zones in the Parks (whole reserves) to maintain some significant sections of forests, excluding any anthropogenic intervention, in order to allow conservation of all extent forest associations and thus their species richness and genetic variation.

In Natura 2000 sites forest operations are subjected to Environmental Incidence Assessment, according to DPR 357/1997. Forest harvesting has to defer to the regional purpose to obtain adequate conservation. Lazio Region promotes long-term sustainable use of forest resource and the restoration of environment in order to protect biodiversity of natural habitats. At the same time it promotes sustainable agrosilvocoltural activities to help local economy in marginal lands and rural areas with the development of local cooperative related to forest products. The revision of Natura 2000 and of DGR about forest planning, currently in progress, is aware of these problems and of the protected surfaces.

Some forest types, such as *Quercus suber* and *Fagus sylvatica* dominated forests, are predominantly situated within protected areas. Given their ecological importance, such forests should be excluded from forest wood removals, thus not to be considered when assessing the potential for bio-energy. *Quercus ilex*-dominated forest and *Quercus cerris* and *Q. frainetto* forests are referred to Natura 2000 habitats, according to Italian Interpretation Handbookl of 92/43/CEE Directive habitats (Biondi and Blasi 2009; Biondi *et al*. 2012) and they only have to go through low-impact operations or disturbances (Table 15).

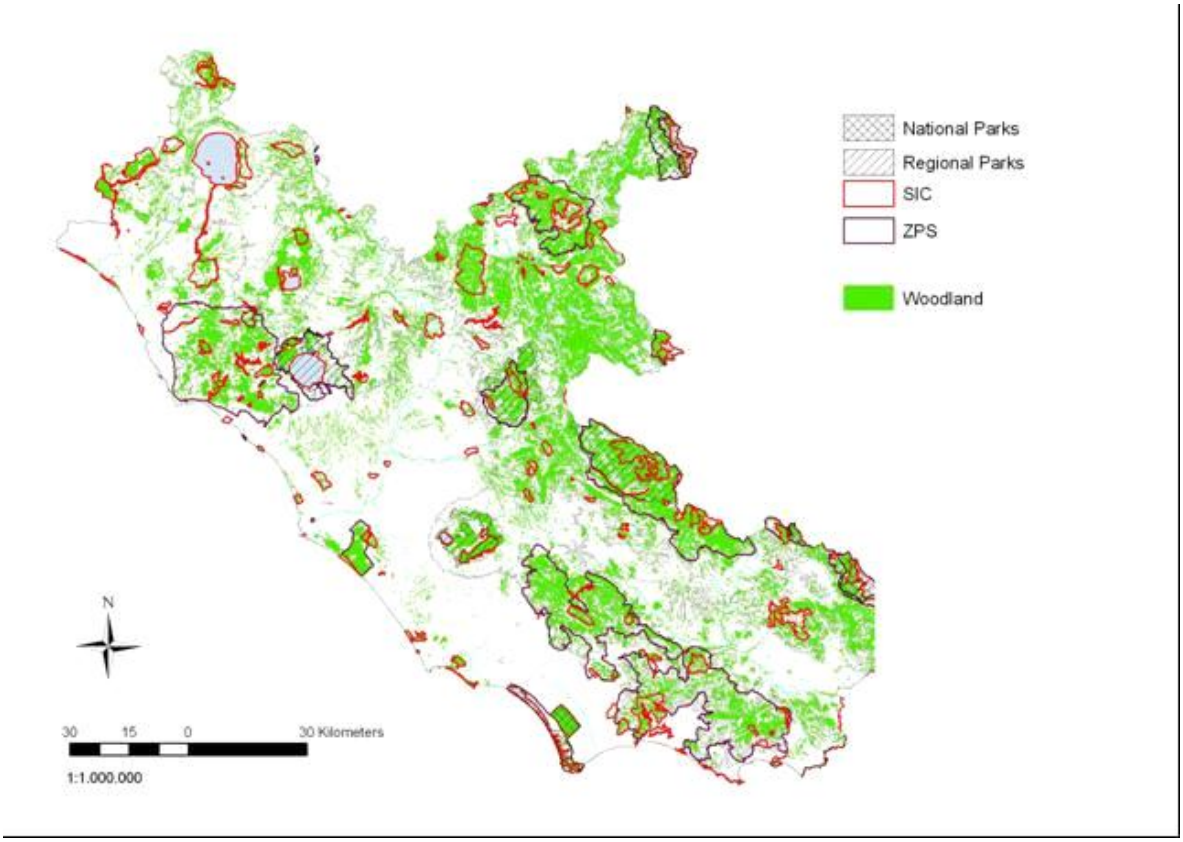

Figure 30. Protected areas and forests in Lazio

Table 15. Forests within protected areas by forest types in Lazio		
Forest type	*Hectares*	*% of forest type*
Quercus suber-dominated forests	1,717.2	0.8
Fagus sylvatica-dominated forests	54,190.8	25.1
Pinus nigra-dominated forests	5,018.8	2.3
Quercus ilex-dominated forests	27,945.4	13.0
Quercus cerris/*Quercus frainetto*-dominated forests	57,412.1	26.6
Castanea sativa-dominated forests	13,944.6	6.5
Ostrya/*Carpinus*-dominated mixed forests	28,897.4	13.4
Quercus pubescens. *Q. robur*. *Q. petraea*-dominated forests	22,554.0	10.5
Mediterranean pine forests	1,991.6	0.9
Plantations of other broadleaved species	213.6	0.1
Hygrophilous forests	1,431.8	0.7
Other evergreen broadleaved forests	51.4	0.1
Populus sp. Planted forests	2.1	0.1
Other deciduous broadleaved forests	107.5	0.1
Total forests	215478,3	100,0

5. FOREST TYPES AND MANAGEMENT

5.1 Coppices

Coppicing represents a traditional method of woodland management and wood production in Italy, in which shoots are allowed to grow up from the base of a felled tree. Harvests are performed in a rototation, a planned number of years between the establishment of a crop (by planting or regeneration) and final felling. Harvests are performed in short intervals (2--6 years) depending on plant material, growth conditions and management practices. Planting, maintenance and harvesting is predominantly done by established agricultural practices allowing farmers to use methods and machines already known from annual crops.

Rotation length of coppices is the planned number of years between the establishment of a crop (by planting or regeneration after cutting) and final felling. Rotation depends on the desired size and quality of poles and is tipically 10-30 years depending on species and site. A coppice may be large, in which case trees, usually oak (*Quercus)*, ash (*Fraxinus)* or hornbean (*Ostrya*), are cut, leaving a massive stool from which up to 10 trunks arise; or small, in which case trees, usually hazel (*Corylus*) or willow (*Salix*), are cut to leave small, underground stools producing many short stems. The system provides a continuous supply of timber for fuel, fencing, etcetera, but not structural timber. Initial growth of a coppice shoot is very vigorous; oak may reach 1 m and ash, beech and sweet chestnut as much as 2 m in the first year. Mean annual increments over a coppice rotation, in terms of dry wood per hectare per year to 5 cm diamter, are typically 2-3 tonnes per oak, lime, alder and sweet chestnut. Poplar and willow may produce as much as 6 tonnes per hectare per year. Coppicing is widespread in Italian forestry and forests due to economic (links with little rural ownership in mountain) and site specific characteristics (hard slope, low hydric disponibility of soil). In Lazio, as well as Umbria, Emilia Romagna, and Toscana, coppices are largely prevailing on high-forests.

Coppices in Lazio extend over 340,657 ha, or 56.2% of total wooded land (Table 11). Of these coppices, 46,425 ha are classified as common coppices; 262,176 ha as coppice with standards (or 77.0% of total coppices) and 32,056 ha as mixed coppice stands (or 5.3% of total coppices).

The annual increment from coppices equals 1,096,021 m^3, with an average net annual increment per hectare equal to 3.2 m^3.

5.2 High forests

High forests in Lazio cover about 97.338 ha, or 17.9% of total wooded land, with an estimated increment of 369,212 m^3 to the wood standing volume is extracted.

In Italy forest stands classified as high forests rarely have a structure and a composition which are referable to a classic model of high forest: even-aged or aneven-aged high forest (INFC, 2007). In fact, especially in the Apennine, forest stands classifed as such have diverse and complex composition and structure, thus not straightforwardly classifiable in one of the two above mentioned categories of high forest. Often we are in the presence of un-managed forest stands, such as forest plantations where the decrease in coverage has favored the ingression of broadleaved species (Nocentini *et al*. 2001), or coppice under high forests that, for various reasons, have been abandoned (Corona *et al*. 2002).

5.3 Forest plantations

In Lazio, forest plantations (or planted forests, see chapter 4.2 of this report) cover about 20,477 hectares, corresponding to 3.8% of total forest area.

5.4 Other wooded lands

In addition to the 543,885 ha of wooded land, there are 61,974 ha of forestland that the Italian Forest Service (CFS) classifies as “other wooded land.” This “other” forestland has low productivity due to a variety of factors or site conditions that adversely affect tree growth.

6. OUTSIDE FORESTS

Outside forest includes forest trees that are present on lands that do not fit into the definition of forest since they do not reach the minimum parameters to be a forest (less than 20 m in width and 0.5 ha in area). It consists of small woodlots, line forest tree and scattered trees.

6.1 Small woodlots, line forest trees and scattered trees

Outside forest includes scattered trees in permanent meadows and pastures; or group of trees or trees in lines along roads, railways, rivers, streams and canals. As suggested by Corona et al. (2009), the standards for identifying the trees outside forests are the followings:

- small woodlot: group of trees with and area between 500 e 5000 m^2 e width less of 20 m;
- line forest trees of at least three plants having a width between 3 e 20 m and a length of at least 20 m (v. INFC. 2003);
- scattered trees: all forest trees not included in small woodlot and line forest (hedgerows and forest tree windbreaks).

Trees outside forest are a constitutive element of traditional Italian agricultural landscape. The intensification of agriculture and mechanization of farming operations have led up to strong contraction of these formations, especially in lowland areas. In recent years, thanks to an active policy of some regional and local governments and the use of EU funds, several linear plantations or small woodlots have been restored or established. This is also the case of Lazio, where the Regional Government has launched a measure to support restoration or establishment of woodlots and linear forests (http://www.agricoltura.regione.lazio.it/binary/prtl_psr/tbl_bnd_bandi/Allegato_alla_DGR_n.369_del_2_settembre_2011_Bando_Misura_216_.pdf).

Outside forest is an important source of wood for fuel (not necessarily stemwood, but woody biomass from shrubs and trees), mostly used as a supply of firewood for domestic use.

Despite having a great importance, not only for the opportunity to provide fuel, but also for the many duties performed, data and quantitative and qualitative information of hedgerows, scattered trees and small woodland patches are scarce and fragmentary.

According to a first survey carried out by ISTAT, the total size of the tree hedgerows amounts to 5,773 km, while the small wood lots occupy a surface equal to 8523 ha. (Ciccarese *et al*. 2003).

The biomass available in the component "outside the forest", located predominantly in the plains and hills, it is mostly used as a supply of firewood for domestic uses. Furthermore, opportunities to support biodiversity priorities and to prevent hydrogeological adversities are creating increasing interest in restoration and establishment of hedgerows, scattered trees and small woodland patches. According to ISTAT, during the period 2008 - 2010, about 274,000 farms (17% of the total) were involved in the maintenance and/or creation of hedgerows, scattered trees, small woodland patches and stonewalls.

These landscape features could support the restoration and buffering of semi-natural habitats making them more resilient to climate change and global change induced stress; and creating effective networks of ecological corridors such as field margins, semi-natural habitat patches and hedgerows to increase connectivity throughout agricultural landscapes allowing species to move and migrate.

For this particular aspect, it is must be emphasized that, from 2008 to 2010, in Lazio more more than seven thoiusands farmlands that have undertaken the establishment and restoration of small woodlots, line forest trees and scattered trees.

7. SHORT-ROTATION FORESTRY PLANTATIONS

In literature many definitions have been used to characterize the epithet 'short rotation forestry' (SRF): short-rotation woody crops, short-rotation intensive culture, short rotation forestry, short-rotation coppice, intensive culture of forest crops, intensive plantation culture, biomass and/or bioenergy plantation culture. In Italy, the expression used for SRF is "Selvicoltura a Breve Rotazione" or "Cedui a Turno Breve" (Facciotto e Mughini 2003, Mughini *et al*. 2007). The concept has evolved over the years. Now it can be meant as a forest plantation at a tree density between 1,100 and 16,000 plants/ha and coppiced from 1 to 5 years, with a length inversely proportional to the planting density. The duration of the planting is provided up to a maximum of 15-20 years. The biomass produced by a 1- or 2-year rotation may be used only to produce energy, because of the high content of bark, including that of 2- or 3- year of industry panels. With the biomass produced in 5 years the options for the farmers are greater: the portion of the stem up to 10 cm in diameter at the upper part may be allocated to the paper mills and the remaining part for producing boards or for energy, depending on the respective market prices. For references see Facciotto e Mughini 2003; Verani e Sperandio 2008)

In the decade 2000-2009 about 7,000 ha of SRF plantations have been established in Italy. Almost all SRF systems for bioenergy have been established in the last decade, mainly due to EU funding. Currently, the acreage is reported to be about 7,000 ha, mainly located in the northern part of Italy and especially in the Po Valley (Lombardy, Veneto, Emilia-Romagna and Piedmont). A few hundred hectares are reported to be located in the South Italy, (Boccasile 2007; Salvati 2007; Verani and Sperandio 2008; JRC/EEA 2008), about 80 ha in Lazio (http://www.regione.lazio.it/binary/agriweb/agriweb_allegati_schede_informative/2007_uo_04.pdf). Recent studies aimed at identifying the areas most suited for the SRF have proposed for this crop the plains of northern Italy and in particular the Po Valley, Friuli Venezia Giulia appears to be the region with the highest degree of diffusion potential, with a surface of 540 ha of suitable areas and more than 262,000 hectares of land marginally suitable (Salvati et al 2007). However the launch of a large-scale plantations program is problematic.

An area dedicated to increase SRF of at least 3,000 to 5,000 it is foreseen in the next 2-3 years, as several new biomass power plants are currently under construction and are being developed in the framework of the reform of the sugar industry. These are based on the supply of biomass from SRF. A database of SRF plantation in Italy has been implemented by the Project SUSCACE (Scientific Support for Agricultural Conversion to Energetic Plantation - http://sito.entecra.it/portale/cra_progetto_dettaglio.php?id_progetto=%2238417d1 0-70e1-a83c-e604-483eb1d1d28a%22&lingua=IT&opz_menu=). The researchers have also developed a GIS application to map SRF plantations.

8. FOREST AREA UNDER SFM CERTIFICATION

The concept of sustainable forest management (SFM) implies the stewardship of forests to ensure that the products and environmental services they provide are available for future generations. International agreements and national policies require foresters to demonstrate that their forestry practices meet independent criteria of sustainability. In Italy, as elsewhere, the increasing emphasis upon sustainability has led to the promotion of 'multiple-use' management which generally means developing varied forests containing stands of different species, ages and structures. The principles of SFM (MCPFE 2006) and a moderate cutting and extraction of wood and non-wood forest products in relation to increment have created positive conditions for biological diversity in many cases, and increased the share of deadwood. Increased extraction of forest residues and complementary fellings may result in an intensification of use of forest resources, which can compromise the nature conservation value of such forests. Residue extraction also affects the composition of flora and fauna through habitat homogenisation and more intense soil disturbance. However, there are also some man-made forests that are not thinned due to a lack of market demand and low prices. In such cases thinning for biomass utilisation provides an opportunity to open very dense coniferous forest plantations, and thereby improve the habitat value of these forests for many species.

A certain amount of deadwood per hectare is increasingly recognised as an important factor in the protection of biodiversity in forests. Of particular importance is deadwood of a large diameter as, although the removal of fine and small woody debris also has an effect on biodiversity, there are many more species that depend on large dead trees. Currently, the amount of deadwood, particularly in commercial forests, is low in many European countries. When extracting forest residues or complementary fellings it is thus important to leave behind a proportion of residues, deadwood and old trees in order not to increase the pressure on biodiversity. This assumption of course would institute an obstacle or deterrence to the valorisation of wood residues for energy purposes.

The Forest Stewardship Council (FSC), funded in 1994, has an international and unique forest management standard including economic, social and environmental criteria, developed and approved by a multystakeholder General Assembly. The PEFC Council (Programme for the Endorsement of Forest Certification schemes) is an independent, non-profit, non-governmental organisation, founded in 1999 which promotes sustainably managed forests through independent third party certificationSFM certification schemes developed at national or regional level. Through the traceability of the "Chain of custody", Tthe FSC and PEFC provides an assurance mechanism to purchasers of wood and paper products that they are promoting the sustainable management of forests.

Currently, two forestland farms of about 2,000 ha each—one in the Province of Rome (a protected area within the system of Parks and Reserves of the Lazio Region) e the second one in the Province of Viterbo, on the border with Tuscany (http://www.vicarello.eu)--have been SFM-certified.

9. FINAL REMARKS

The scope of this report was to provide regional and local policymakers in Lazio the essential information and data to develop clear national-level policy goals for forests and energy that reflect the principles of sustainable development and sustainable forest management. It will serve as a basis for assessing firstly the biological and secondly the socio-economic potential of forest-based woodstocks in Lazio, respecting the principles of sustainable management. In fact the use of bioenergy raises a number of issues relating to the sustainability *sensu lato*, which implies the evaluation of the potential of bio-energy production and the impacts on the future management of and quality of lands and forests, food security, social structures, biodiversity. In point of fact, the 2009 EU Renewable Energy Directive (RED) sets sustainability and compliance criteria for biofuels. In particular, concerning the sustainability of woody biomass used for power and heat production, the RED asks for supplementary explanations from member states.

Consideration should also be give to trade-offs between wood energy, agro-fuels and other energy sources and land-use options.

More in-depth studies on regional and local level are needed in order to obtain quantitative results of such an analysis.

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