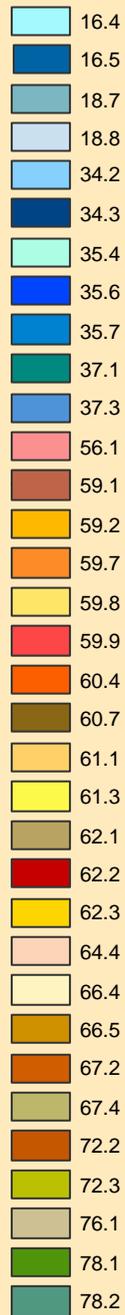


# SOIL REGIONS OF ITALY

## Legend



Italian National Council for  
Agricultural Research



Italian Ministry of Agriculture  
Policies and Forestry



Experimental Institute for Soil  
Study and Conservation



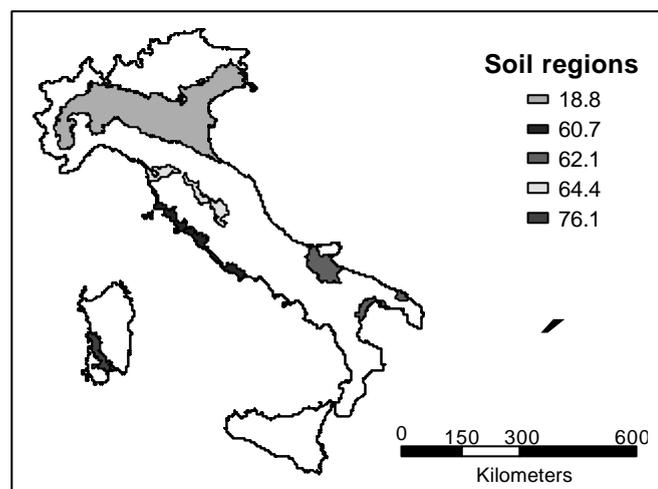
Italian National Center for  
Soil Mapping

## SOIL REGIONS OF ITALY

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www.soilmaps.it

The soil region data base, scaled 1:5,000,000, is the first informative level for the soil map of Italy and, at the same time, is the tool for soil correlation at the continental level. Soil regions are a regionally restricted part of the soil cover characterized by a typical climate and parent material association. The description of the main soil degradation processes, according to their occurrence in the different soil regions, instead of administrative regions, permits to take into account local specificity and, at the same time, to avoid redundancies. The soil regions database was matched with the Corine land cover and the soil national database, which is maintained by the Italian National Center for Soil Mapping, part of the Experimental Institute for Soil Study and Conservation, to appreciate specific soil characteristics.

### Soil regions of the Italian alluvial and coastal plains, and associated low hills



#### 18.8 Po plain and moraine hills of Piedmont and Lombardy

**Surface** 49546 km<sup>2</sup>, 16.4% of Italy.

**Climate and pedoclimate:** temperate-suboceanic; in coastal areas: warm temperate-oceanic and suboceanic, partly submediterranean; mean annual air temperature: 11-13°C; mean annual precipitations: 690-1200 mm; rainiest months: May and October; dry months: July and August; months with mean temperatures under 0°C: January, no one in the areas near the coast. Soil moisture regime: udic and subordinately ustic, locally xeric; temperature regime: mesic and subordinately thermic.

**Geology and morphology:** Quaternary alluvial and glacio-fluvial deposits. Level land, mean altitude: 95 meters above sea level (standard deviation 110), mean slope: 1% (std 5).

**Main soils:** soils with pedogenetic structure in depth and weakly differentiated profile (Eutric, Chromic and Calcaric Cambisols); recent alluvial soils (Eutric and Calcaric Fluvisols); soils with reorganization of carbonates (Haplic Calcisols); soils decarbonated and rich in iron oxides, with clay accumulation along the profile (Haplic, Gleyic and Chromic Luvisol); sandy and weakly developed soils (Calcaric Arenosols and Regosols); soils with vertic properties and reorganization of carbonates (Gleyic and Vertic Cambisols, Eutric, Gypsic and Calcic Vertisols); more or less shallow soils on limestone with organic matter accumulation (Rendzic Leptosols; Calcaric Phaeozems); soils with shallow water table (Eutric Gleysols; Thionic Fluvisols and Cambisols); soils with organic matter accumulation (Ombric and Thionic Histosols).

**Main land capability classes:** 1<sup>st</sup> and 2<sup>nd</sup> class soils, with local limitations for acidity, stoniness, water excess, clayey texture, peat.

**Main soil degradation processes:** the high potential agricultural productivity of soils conflicts with the other kinds of utilization, which have been steadily occupying the territory during the last decades. Some 9.9% of the soil region is now occupied by extra-agricultural uses (urban areas, industrial settlements, quarries, infrastructures, etc.) with maximum concentration in the high plain, 12.5%, and on moraine hills, 16.9% of the surface. Soil are generally fertile, although often poor in organic matter. The intensive agricultural use (60.5% of the surface is utilized as row and close-grown crops and only 6.8% as meadow or woodland) can cause degradation of soil

physical and chemical condition, as well as groundwater contamination, especially where the organic matter and pH are low or very low (western part of the soil region). The groundwater pollution risk is particularly high in irrigated land (7.4% of the soil region, concentrated in the medium and high plain) especially in rice cultivated lands (western part of the soil region), and in the recently reclaimed territories of the eastern part. The soil region is covered for to 8.4% by water bodies, which are more widespread near the Po delta. In the recently reclaimed area, subsidence is still taking place, and an increase in the diffusion of soil salinization has been signalled.

#### 64.4 Versilia and internal plains of Tuscany, Umbria and Lazio

**Surface** 5223 km<sup>2</sup>, 1.7% of Italy.

**Climate and pedoclimate:** Mediterranean oceanic and suboceanic; mean annual air temperature: 12-15°C; mean annual precipitation: 850-1100 mm; rainiest months: October and November; dry months: July and August; months with mean temperatures under 0°C: no one. Dominant soil moisture and temperature regime: udic, thermic.

**Geology and morphology:** Quaternary alluvial and lacustrine deposits. Mainly level land, mean altitude: 184 meters a.s.l. (std 145), mean slope: 4% (std 9).

**Main soils:** alluvial soils, with shallow water table and organic matter accumulation (Eutric Gleysols, Fluvisols and Cambisols; Ombric Histosols); weak vertic properties (Vertic Cambisols); decarbonated soils, rich in iron oxides, with clay accumulation along the profile (Haplic, Chromic and Gleyic Luvisols).

**Main land capability classes:** 1<sup>st</sup>, 2<sup>nd</sup> and 5<sup>th</sup> class soils, with limitations for flood risk, water excess, clayey texture, locally for acidity, stoniness, salinity or peat.

**Main soil degradation processes:** also this soil region shows a high conflict between different land uses. Row and close-grown crops cover some 44.1% of the area, while urban areas, quarries, refuse heaps and other extra-agriculture uses cover to 10.6%; the presence of woodlands and meadow however is not negligible, that is 15.5%, somehow linked to the presence of water bodies (3% of the soil region) and acid paleosols. Degradation of soil physical quality (namely compaction) has been indicated in many places and attributed to the intensive agricultural exploitation and to the low soil organic matter content.

#### 60.7 Coastal plains of central Italy and included hills

**Surface** 4985 km<sup>2</sup>, 1.6% of Italy.

**Climate and pedoclimate:** Mediterranean to subcontinental and continental; mean annual air temperature: 14-17°C; mean annual precipitations: 620-1000 mm; rainiest months: October and December; dry months: June, July and August; months with mean temperatures under 0°C: no one. Soil moisture and temperature regime: xeric, thermic.

**Geology and morphology:** Quaternary alluvial deposits with inclusions of Tertiary metamorphic rocks. Level land, mean altitude: 76 meters a.s.l. (std 99), mean slope: 7% (std 12).

**Main soils:** alluvial soils, sometimes with shallow water table (Calcaric Cambisols, Fluvisols and Gleysols); soils with clay accumulation along the profile (Chromic, Calcic, Gleyic, Haplic and Vertic Luvisols); soils with vertic properties and reorganization of carbonates (Vertic Cambisols; Eutric, Calcaric and Calcic Vertisols), saline soils (Solonchaks).

**Main land capability classes:** 1<sup>st</sup>, 2<sup>nd</sup> and 5<sup>th</sup> class soils in plane, with limitations for water excess, clayey texture, drought, locally for acidity; 4<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> class soils on hills, for stoniness, rockiness, slope and acidity.

**Main soil degradation processes:** the region is mainly utilized with row and close-grown crops (around 50% of the total surface) which are widespread in the plains, while hills are mainly covered by forest and meadows (around 25% of the region). The most important soil degradation processes are here attributed to the competition between agricultural and not-agricultural uses of water. The competition is due to the scarcity of water bodies (only 1% of the region) and to the dry Mediterranean climate, and it is particularly harsh in the plains, where settlement are concentrated (6.2% of the region is covered by not-agricultural uses). As to consequence, localized, but severe soil degradation phenomena are claimed, due to the use of brackish waters. In addition, relevant phenomena of groundwater pollution are signalled in the intensively cultivated plains of the southernmost part of the region.

#### 62.1 Capitanata and plains of Metaponto, Taranto and Brindisi

**Surface** 6377 km<sup>2</sup>, 2.1% of Italy.

**Climate and pedoclimate:** Mediterranean subtropical; mean annual air temperature: 12-17°C; mean annual precipitation: 400-800 mm; rainiest months: October and November; dry months: May to September; months with mean temperatures under 0°C: no one. Soil moisture and temperature regime: xeric and dry xeric, thermic.

**Geology and morphology:** Quaternary alluvial and marine deposits mainly clay and loam, with hollow limestone. Level land, mean altitude: 101 meters a.s.l. (std 93), mean slope: 3% (std 5).

**Main soils:** soils with vertic properties and reorganization of carbonates (Calcic Vertisols; Vertic, Calcic and Gleyic Cambisols; Chromic and Calcic Luvisols; Haplic Calcisols); alluvial soils (Eutric Fluvisols), saline soils (Solonchaks).

**Main land capability classes:** 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> class soils, with limitations for clayey texture, stoniness, drought and salinity.

**Main soil degradation processes:** soil degradation processes due to competition between agricultural and not-agricultural uses of water are here made stronger because the even drier Mediterranean climate and the more intense urbanization. Evidences of localized soil alcalinization, besides salinization, are reported.

### 76.1 Campidano and plains of Sulcis and central Sardinia

**Surface** 2493 km<sup>2</sup>, 0.8% of Italy.

**Climate and pedoclimate:** Mediterranean subtropical; mean annual air temperature: 16-18°C; mean annual precipitation: 400-800 mm; rainiest months: November and December; dry months: June to September; months with mean temperatures under 0°C: no one. Soil moisture and temperature regime: dry xeric and thermic.

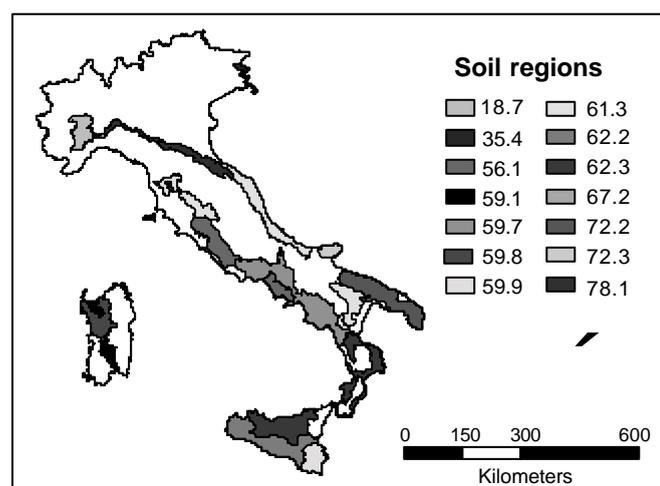
**Geology and morphology:** Quaternary alluvial deposits. Level land, mean altitude: 63 meters a.s.l. (std 94), mean slope: 3% (std 8).

**Main soils:** soils with clay accumulation along the profile and reorganization of carbonates (Calcic, Haplic and Gleyic Luvisols); soils rich in iron oxides (Haplic Nitisols); alluvial soils (Eutric, Calcic and Mollic Fluvisols); soils with shallow water table and salt accumulation (Gleyic Arenosols and Solonchaks); soils with vertic properties (Eutric and Calcic Vertisols); soils with organic matter accumulation on surface or hard limestone in depth (Mollic Leptosols; Petric Calcisols).

**Main land capability classes:** 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 8<sup>th</sup> class soils, with limitations for clayey texture, drought, water excess and locally for acidity, salinity or calcareous crusts.

**Main soil degradation processes:** the region is characterized by an intensive use, both agricultural and extra-agricultural. Although settlements cover to not very high portion of the territory (slightly more than 5%) they are concentrated in the most fragile part of it, near the Mediterranean coast and water bodies (5.8% of the region) and often on the most fertile soils. Sand and gravel quarries are also signalled to be particularly diffused just on the most fertile soils. Rainfed agriculture covers to 37.4% of the area, irrigated crops to 13.7%, and tree crops to 28%; woodland is only 10% of the region. Peculiar of this area is the abundance of paleosols, often rather acid, poor in organic matter, somewhat poorly drained and with the presence of hardened calcic horizons. These soils are particularly sensible to degradation when irrigated with brackish or rich in calcium carbonate waters; in this last case, the salt tends to accumulate inside the profile and to reform in few years the petrocalcic horizon which farmers usually broken to allow crop root penetration.

## Soil regions of the Italian hills



### 18.7 Langhe, Monferrato and "hills of the Po" on Tertiary marine deposits

**Surface** 3963 km<sup>2</sup>, 1.3% of Italy.

**Climate and pedoclimate:** temperate suboceanic; mean annual air temperature: 10-13°C; mean annual precipitation: 730-850 mm; rainiest months: October and November; dry months: June and July; months with mean temperatures under 0°C: January. Soil moisture and temperature regime: xeric to udic, mesic.

**Geology and morphology:** Tertiary marine deposits. Sloping land, mean altitude: 310 meters a.s.l. (std 145), mean slope: 16% (std 16).

**Main soils:** eroded soils (Calcic Cambisols and Regosols); alluvial soils (Calcic Fluvisols); soils with clay accumulation (Haplic and Gleyic Luvisols).

**Main land capability classes:** 3<sup>rd</sup> and 4<sup>th</sup> class soils, with limitations for erosion and slope.

**Main soil degradation processes:** water soil erosion, superficial and deep-seated mass movements are frequent and widespread, often made worse because the practices of land levelling, particularly diffused before the settlement of tree crops (vineyards), and of slope reshaping, which is common in lands prone to superficial mass movements. The severe and continuous soil erosion is one of the major causes of the low organic carbon content of many of the soils of these regions. In many areas of the territory, the substitution of the traditional mixed culture (small fields with simultaneous cultivation of close-grown and row crops, vegetables, orchards and other tree plantations) with an alternating of large fields with specialized tree plantations and close-grown or row crops, causes the loss of an attractive traditional landscape, as well as of the cultural value of soils.

### 78.1 Hills of Emilia-Romagna and Marche on Tertiary flysch deposits

**Surface** 5467 km<sup>2</sup>, 1.8% of Italy.

**Climate and pedoclimate:** temperate suboceanic; mean annual air temperature: 9-12.5°C; mean annual precipitation: 800-1100 mm; rainiest months: October and November; dry months: July and August; months with mean temperatures under 0°C: January. Soil moisture and temperature regime: udic and ustic, mesic.

**Geology and morphology:** mostly arenaceous flysch and alluvial deposits. Sloping land, mean altitude: 303 meters a.s.l. (std 153), mean slope: 22% (std 16).

**Main soils:** soils eroded and with reorganization of carbonates (Calcic and Vertic Cambisols; Eutric and Calcic Leptosols and Regosols; Haplic Calcisols); soils rich in oxides and clay accumulation (Haplic and Ferric Luvisols).

**Main land capability classes:** 3<sup>rd</sup> and 4<sup>th</sup> class soils for thickness, stoniness, clayey texture, erosion and slope.

**Main soil degradation processes:** similar to soil region 18.7.

### 61.3 Hills of central and southern Italy on Pliocene and Pleistocene marine deposits

**Surface** 16490 km<sup>2</sup>, 5.4% of Italy.

**Climate and pedoclimate:** Mediterranean and Mediterranean suboceanic; mean annual air temperature: 12.5-16°C; mean annual precipitation: 700-1000 mm; rainiest months: November; dry months: July and August; months with mean temperatures under 0°C: no one. Soil moisture and temperature regime: xeric, locally udic, thermic.

**Geology and morphology:** Pliocene and Pleistocene marine sediments and Holocene alluvial sediments. Sloping land with included valleys, mean altitude: 233 meters a.s.l. (std 156), mean slope: 13% (std 12).

**Main soils:** soils eroded and with reorganization of carbonates (Eutric and Calcic Regosols; Calcic Cambisols; Haplic Calcisols); soils with clay accumulation (Haplic and Calcic Luvisols); soils with vertic properties (Vertic Cambisols and Calcic Vertisols); alluvial soils (Calcic, Eutric and Gleyic Fluvisols).

**Main land capability classes:** 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> class soils, for erosion and slope, subordinately for clay and limestone content excess.

**Main soil degradation processes:** similar to soil region 18.7.

### 67.2 Carso and 35.4 hills of Friuli

**Surface** 958 km<sup>2</sup>, 0.3% of Italy.

**Climate and pedoclimate:** warm temperate subcontinental to Mediterranean; mean annual air temperature: 7-15°C; mean annual precipitation: 1000-2800 mm; rainiest months: October and November; dry months: July and August (67.2), no one (35.4); months with mean temperatures under 0°C: no one (67.2), January (35.4). Soil moisture and temperature regime: udic, thermic and mesic.

**Geology and morphology:** limestone, dolomite, flysch, marl and residual deposits. Mainly undulated land, mean altitude: 325 meters a.s.l. (std 181), mean slope: 26% (std 22).

**Main soils:** shallow soils, with organic matter accumulation on surface or with clay and iron oxides accumulation in depth (Lithic, Umbric, Eutric Leptosols; Leptic, Eutric and Chromic Cambisol; Leptic and Chromic Luvisols).

**Main land capability classes:** 3<sup>rd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> class soils, for thickness, stoniness, rockiness and slope

**Main soil degradation processes:** local water erosion and mass movements.

### 72.3 Hills of Gargano

**Surface** 1524 km<sup>2</sup>, 0.5% of Italy.

**Climate and pedoclimate:** Mediterranean to Mediterranean suboceanic, partially mountainous; mean annual air temperature : 10-17°C; mean annual precipitation: 400-1200 mm; rainiest months: October and December; dry months: July and August; months with mean temperatures under 0°C: no one. Soil temperature moisture regime: xeric, thermic, subordinately udic, mesic.

**Geology and morphology:** Mesozoic limestone and calcareous marl and residual deposits. Sloping land and level land with depressions, mean altitude: 408 meters a.s.l. (std 266), mean slope: 19% (std 18).

**Main soils:** soils rich in iron oxides and clay accumulation in depth (Chromic Cambisols and Luvisols).

**Main land capability classes:** 3<sup>rd</sup>, 6<sup>th</sup> and 7<sup>th</sup> class soils, for thickness, rockiness, stoniness and slope.

**Main soil degradation processes:** limited soil consume by tourist and industrial dwellings in coastal areas.

## **72.2 Hills of Murge and Salento**

**Surface:** 10627 km<sup>2</sup>, 3.5% of Italy.

**Climate and pedoclimate:** Mediterranean subcontinental to continental; mean annual air temperature : 14-20°C; mean annual precipitation: 420-700 mm; rainiest months: October and November; dry months: June to August; months with mean temperatures under 0°C: no one. Soil moisture and temperature regime: xeric, subordinately dry xeric, thermic.

**Geology and morphology:** Mesozoic limestone and marl and residual deposits. Level land and moderately sloping land, mean altitude: 191 meters a.s.l. (std 155), mean slope: 3% (std 5).

**Main soils:** shallow and eroded soils (Eutric Cambisols; Calcaric Regosols; Calcaric and Rendzic Leptosols); soils with carbonates, clay and iron oxides accumulation in depth (Chromic and Calcic Luvisols); anthropic soils made by landfill and rock mill (Aric and Anthropic Regosols).

**Main land capability classes:** 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> class soils, for thickness, rockiness and drought.

**Main soil degradation processes:** the smooth morphology favors the consume and the diffusion of urban, tourist and industrial sites, especially along the coast (almost 500 km). The dryness of the climate (dry xeric pedoclimate) and the scantiness of water resources provoke to hard competition between their different uses. The utilization of bad-quality water for irrigation is common. As to consequence, almost 4,000 km<sup>2</sup> are supposed to be affected by salinization and alcalinization. Another 20 km<sup>2</sup> are estimated to present heavy metal contamination, due to the spreading or urban sludge. The soils of the region are frequently shallow, and soil losses due to water erosion are particularly grave in the higher hills. The risk of soil erosion, up to complete denudation of the underlying hard rock, is increased by the practice of chopping the rock, operated with particularly heavy machinery, and by surface levelling. These practices, in addition to earth movements and backfill, has already interested some 1,000 km<sup>2</sup>, often constituted by traditional landscapes, formed by picturesque red-colored paleosols alternating with white rocks. In these cases, the loss of the cultural value of soils, besides the impairment of the attractiveness of the landscape, was observed.

## **56.1 Hills of central and southern Italy on effusive volcanic rocks**

**Surface:** 8702 km<sup>2</sup>, 2.8% of Italy.

**Climate and pedoclimate:** mediterranean oceanic to suboceanic; mean annual air temperature: 13-17°C; mean annual precipitation: 750-1000 mm; rainiest months: October and January; dry months: July to September; months with mean temperatures under 0°C: no one. Soil moisture and temperature: xeric, thermic, subordinately udic, mesic.

**Geology and morphology:** extrusive igneous rocks. Sloping and level land, escarpment and included valleys, 0 mean altitude: 200 meters a.s.l. (std 169), mean slope: 10% (std 12).

**Main soils:** soils with more or less expressed characters derived from volcanic materials (Eutric and Dystric Cambisols; Humic Umbrisols; Haplic, Umbric and Vitric Andosols); soils with clay and iron oxides accumulation (Haplic and Chromic Luvisols); alluvial soils (Eutric Fluvisols); soils of anthropic terraces (Anthropic Regosols).

**Main land capability classes:** 1<sup>st</sup> and 2<sup>nd</sup> class soils in valleys, 6<sup>th</sup> in sloping lands, with limitations due to erosion, slope, clayey texture, locally to acidity.

**Main soil degradation processes:** these lands have a good suitability for both agricultural and forest uses, but suffer from a heavy extra-agricultural exploitation, which is the main cause of soil degradation. Extra-agricultural uses are, on average, 11.5% of the region, but up to more than 50% in the southern part. Row and close-grown crops cover a 30.9%, irrigated crops a 7.5%, meadows and woodlands about 12.4%. Localized, but important cases of soil pollution, due to a over-intensive agricultural use, have been observed. Water soil erosion and mass movements are common, and often interest the characteristic landscapes of the human-terraced slopes, which are in many cases abandoned.

## **62.3 Hills of Calabria and Sicily on Tertiary calcareous rocks and sediments, with included alluvial and coastal plains**

**Surface:** 14898 km<sup>2</sup>, 4.9% of Italy.

**Climate and pedoclimate:** Mediterranean continental, subcontinental and subtropical; mean annual air temperature: 13-18°C; mean annual precipitation: 450-1000 mm; rainiest months: October and January; dry months: June to September; months with mean temperatures under 0°C: no one. Soil moisture and temperature regime: xeric and dry xeric, locally ustic, thermic, locally mesic.

**Geology and morphology:** Tertiary calcareous and dolomitic rocks, Quaternary alluvial deposits. Sloping and level land, escarpment and included valleys, mean altitude: 431 meters a.s.l. (std 331), mean slope: 24% (std 17).

**Main soils:** eroded soils (Eutric and Calcaric Regosols); soils with accumulation of carbonates and more soluble salts and with vertic properties (Calcaric and Vertic Cambisols; Haplic Calcisols; Calcic Vertisols; Solonchaks); soils rich in iron oxides and clay accumulation (Chromic, Calcic and Haplic Luvisols); alluvial soils (Eutric Cambisols and Fluvisols; Gleyic Cambisols), soils on volcanic ashes (Umbric Andosols).

**Main land capability classes:** 2<sup>nd</sup> and 3<sup>rd</sup> class soils in level lands, 3<sup>rd</sup> to 8<sup>th</sup> in sloping lands, with limitations for clayey texture, drought and salinity, thickness, stoniness, slope and erosion.

**Main soil degradation processes:** they are attributed to water soil erosion, on the hills, and to competition between agricultural and not-agricultural uses of water on the plains. Localized soil salinization is lamented for the soils placed near the Ionic sea coast. Superficial soil erosion and mass movements are very common and contribute to the low organic matter content of many agricultural soils.

## **62.2 Hills of Sicily on Tertiary clayey flysch, limestone, sandstone and gypsum, and coastal plains**

**Surface:** 10431 km<sup>2</sup>, 3.4% of Italy.

**Climate and pedoclimate:** Mediterranean subtropical; mean annual air temperature: 16-20°C; mean annual precipitation: 450-670 mm; rainiest months: November and January; dry months: May to September; months with mean temperatures under 0°C: no one. Soil moisture and temperature regime: xeric and dry xeric, thermic.

**Geology and morphology:** Tertiary clayey flysch, sandstone and gypsum. Sloping land with included valleys, level coastal land, mean altitude: 247 meters a.s.l. (std 161), mean slope: 12% (std 13).

**Main soils:** soils with accumulation of carbonates and more soluble salts and with vertic properties (Eutric, Calcaric and Vertic Cambisols; Haplic Calcisols; Eutric and Calcic Vertisols; Solonchaks); eroded soils (Eutric and Calcaric Regosols); soils with carbonates and with clay accumulation (Haplic and Calcic Luvisols); alluvial soils (Eutric and Calcaric Fluvisols).

**Main land capability classes:** variable, from 1<sup>st</sup> the 3<sup>rd</sup> class soils in level land, from 3<sup>rd</sup> to 7<sup>th</sup> in hills, with limitations for slope and water erosion, clayey texture, drought and salinity, locally for thickness, rockiness and stoniness

**Main soil degradation processes:** they are the same of the previous region, but the consequences are even more severe, because the soil region has a more intensive use of land, both for agriculture and extra-agricultural uses (3.6% of the area). More than one half of the surface is covered by specialized or mixed tree cultivation (citrus, vineyards, orchards, olive and almond tree plantations) while meadows and forests are less than 10%. Besides soil erosion, salinization is an outstanding problem. It is estimated that some 2500 km<sup>2</sup> of soils, generally with high production potential and placed in plains, are affected by salinity. A large part of the area (around 1,200 km<sup>2</sup>) is constituted by terraces on which paleosols, often poor in organic matter, are widespread. Where these soils are deeply ploughed, impressive phenomena of soil compaction have been observed (hardsetting). The diffusion of specialized tree cultivation on these paleosols, namely vineyards for wine and table grape production, has caused a deep upset of soil horization and a perturbation of the landscape in large areas, with loss of pedodiversity and traditional characteristic of the cultural landscape. The intensive cultivation is also blamed to be responsible for soil contamination, produced by the overuse of pesticides and the burning of plastic covers.

## **59.7 Hills and mountains on limestone covered by volcanic ashes of southern Italy, and included alluvial and coastal plains**

**Surface:** 14908 km<sup>2</sup>, 4.9% of Italy.

**Climate and pedoclimate:** Mediterranean oceanic to suboceanic; mean annual air temperature: 11-17°C; mean annual precipitation: 750-1200 mm; rainiest months: December and January; dry months: July and August; months with mean temperatures under 0°C: no one. Soil moisture regime: xeric along the coasts and udic in the inner land; soil temperature regime: thermic, mesic on the mountains.

**Geology and morphology:** Mesozoic and Tertiary calcareous rocks with pyroclastic coverage and Quaternary alluvial deposits. Sloping land with

included valleys, level coastal land, 0 mean altitude: 551 meters a.s.l. (std 395), mean slope: 28% (std 24).

**Main soils:** shallow soils on limestone (Lithic, Mollic, Eutric and Rendzic Leptosols); soils with vertic properties and reorganization of carbonates (Eutric and Calcaric Cambisols and Vertisols); alluvial soils (Eutric Fluvisols; Gleyic Cambisols); soils with more or less expressed characters derived from volcanic materials (Umbric and Vitric Andosols); soils of anthropic terraces (Anthropic Regosols).

**Main land capability classes:** 6<sup>th</sup> and 7<sup>th</sup> class soils, 1<sup>st</sup> and 2<sup>nd</sup> in level land, with limitations for thickness, high erosion risk, slope, stoniness and rockiness, clayey texture.

**Main soil degradation processes:** these lands have been subjected to strong erosion for centuries, so that about 5,000 km<sup>2</sup> have been completely denuded and desertified. The process is still going on, although less intensively now, and it is accompanied by frequent episodes of soil slumping, which can affect the underlying strongly populated plain (the 2.6% of urban areas of the region is mainly concentrated in the few plains). The intense agricultural use of the region, which interested in the past also the steep slopes, is testified by the diffusion of terraces, which are in most cases abandoned now, and prone to erosion.

### 59.1 Hills of Sardinia on basic rocks and 59.8 on basalt and trachyte

**Surface** 7695 km<sup>2</sup>, 2.5% of Italy.

**Climate and pedoclimate:** Mediterranean subcontinental and continental; mean annual air temperature: 15-20°C; mean annual precipitation: 600-1200 mm; rainiest months: November and December; dry months: July to September; months with mean temperatures under 0°C: no one. Soil moisture and temperature regime: xeric, thermic.

**Geology and morphology:** Triassic and Miocene sedimentary rocks, basalt and trachyte, partially metamorphic rocks. Sloping and level lands, mean altitude: 280 meters a.s.l. (std 178), mean slope: 13% (std 14).

**Main soils:** shallow soils (Eutric and Lithic Leptosols); soils with pedogenetic structure in depth and weakly differentiated profile (Eutric and Vertic Cambisols); soils with vertic properties (Eutric and Calcic Vertisols); soils with iron oxides and clay accumulation (Haplic Nitisols and Luvisols), soils with carbonates (Haplic Calcisols), soils with organic matter (Phaeozems).

**Main land capability classes:** 2<sup>nd</sup> and 3<sup>rd</sup> class soils in agricultural areas, 7<sup>th</sup> and 8<sup>th</sup> in forestry and grazing lands, with limitations for thickness, high erosion risk, slope, clayey texture, stoniness, rockiness, drought, acidity.

**Main soil degradation processes:** soil degradation is mainly induced by excessive grazing and by fires, which can cause soil erosion, up to the complete stripping of soil and consequent desertification. Soil region 59.8, in particular, has 2% of the surface completely bare yet. Soil region 59.1, on the other hand, is covered by non-agricultural uses for a 4%, which are concentrated in the limited plains, while meadows and forests occupy only a 14.2%. Localized severe pollution is reported near many mine disposals.

### 59.9 Hills and mountains on limestone and igneous rocks of Sicily

**Surface** 3638 km<sup>2</sup>, 1.2% of Italy.

**Climate and pedoclimate:** Mediterranean subtropical; mean annual air temperature: 16-20°C; mean annual precipitation: 350-520 mm; rainiest months: October and January; dry months: May to September; months with mean temperatures under 0°C: no one. Soil moisture and temperature regime: xeric and dry xeric, thermic.

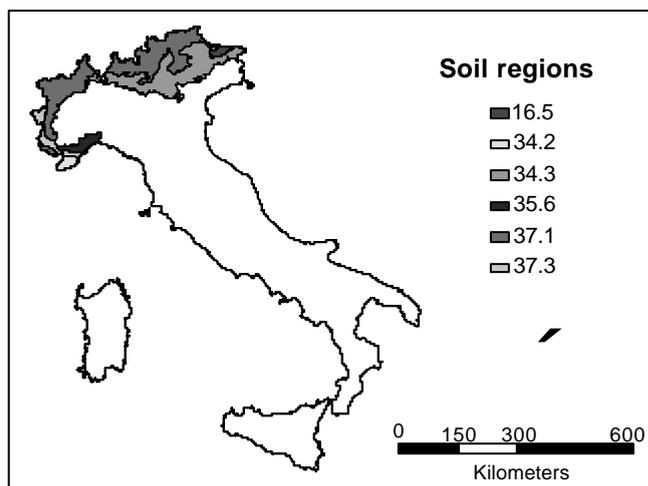
**Geology and morphology:** limestone, dolomitic limestone and volcanic rocks. Sloping land, mean altitude: 297 meters a.s.l. (std 221), mean slope: 11% (std 14).

**Main soils:** more or less shallow soils with organic matter accumulation on surface (Lithic, Mollic, Eutric and Rendzic Leptosols); soils with pedogenetic structure in depth and weakly differentiated profile (Eutric and Calcaric Cambisols).

**Main land capability classes:** 6<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> class soils, with limitations for thickness, slope, clayey texture, stoniness, rockiness, drought, acidity.

**Main soil degradation processes:** the strong urbanization, concentrated along the coasts, occupies a 5.5% of the region. Besides soil loss by cementification, the agricultural areas placed in the small coastal plains are affected by soil salinization. On the relieves, woodlands and permanent meadows are scarce (18.5%), while extensive tree cultivation dominates (48.3%), and soil degradation processes are limited to moderate water erosion.

## Soil regions of the Alps



### 34.2 Western Alps on calcareous sedimentary rocks and 37.3 - 35.6 on metamorphic rocks

**Surface** 6887 km<sup>2</sup>, 2.2% of Italy.

**Climate and pedoclimate:** warm temperate and temperate mountainous; mean annual air temperature: 8-15°C (soil region 37.3: 2-14°C); mean annual precipitation: 700-1200 mm; rainiest months: May and October; dry months: July and August (soil region 37.3: no one); months with mean temperatures under 0°C: no one (soil region 37.3: December to February). Soil moisture regime: udic, locally xeric or ustic along the coast of Ligurian sea; soil temperature regime: mesic and cryic, thermic along the coast.

**Geology and morphology:** Mesozoic and Tertiary calcareous and metamorphic, granite and dolomitic limestone. Sloping land, mean altitude: 958 meters a.s.l. (std 489), mean slope: 42% (std 25).

**Main soils:** shallow soils of highest elevations (Lithic Cryosols); more or less shallow and acid soils with organic matter accumulation on surface (Lithic, Umbric, Rendzic, Eutric and Dystric Leptosols); more or less acid soils with organic matter, iron oxides and aluminium accumulation (Dystric Cambisols; Haplic and Cambic Podzols, Humic Umbrisols); soils of anthropic terraces (Anthropic Regosols).

**Main land capability classes:** 4<sup>th</sup> to 8<sup>th</sup> class soils on the relieves, with strong limitations for climate, slope, thickness, rockiness, stoniness, acidity, 2<sup>nd</sup> and 3<sup>rd</sup> class soils in the valleys.

**Main soil degradation processes:** lands with high potential water soil erosion and landslides risk, but forest and permanent meadow are the dominant land covers (about 72.4% of the area) and for this reason actual strong soil erosion is only indicated for the abandoned agricultural fields. Landslides, on the other hand, can affect also woodland, but they generally occur only in occasion of critical meteorological events. About the other agricultural uses, tree cultivation (especially vine and apple tree) is the most widespread (around 9.2%). Vineyards and many apple tree plantations are traditionally cultivated on human made-terraces, which are more or less maintained or subjected to mass movements in dependence of the financial support provided by different local administrations. Vine cultivation, in addition, has been found associated to copper soil contamination. Bare lands (glaciers, rock outcrops, talus, etc.) cover on average some 13.6% of the surface. They reach a 25% in the central-western part, whereas they are 7.5% in the central-eastern. Settlement distribution shows an opposite trend: it covers as a whole a 1.8%, but only a 1.3% in the central-western part, and a 3.7% in the central-eastern one, however, in both cases it is a major cause of soil consume, because it is concentrated in the few plain surfaces (valley bottoms and terraces). In the lower part of the area, the pre-Alps, the recurrence of fires, which has increased in the last years, provokes the impairment of soil qualities and triggers soil water erosion in otherwise preserved areas. Finally, localized soil degradation phenomena are remarked: i) due to soil erosion related to ski slope, ii) to nitrate contamination in too intensively pastured meadows, iii) to soil acidification in the most elevated forest and meadow lands placed on acid lithotypes.

### 37.1 Western and central Alps on igneous and metamorphic rocks

**Surface** 25360 km<sup>2</sup>, 8.3% of Italy.

**Climate and pedoclimate:** temperate mountainous; mean annual air temperature: 08-10°C; mean annual precipitation: 650-1500 mm; rainiest months: May and August; dry months: no one; months with mean temperatures under 0°C: January and February. Soil moisture regime: udic, locally ustic (valley bottom) or perudic; soil temperature regime: cryic and mesic.

**Geology and morphology:** metamorphic and igneous rocks, Holocene alluvial deposits. Sloping land with included valleys, mean altitude: 1680 meters a.s.l. (std 721), mean slope: 53% (std 30).

**Main soils:** shallow soils of highest elevations (Lithic Cryosols); shallow soils (Lithic, Umbric and Dystric Leptosols); eroded soils (Eutric and Calcaric Regosols); more or less acid soils with organic matter, iron oxides and aluminium accumulation (Dystric Cambisols; Haplic Podzols, Humic Umbrisols); soils with organic matter accumulation on surface (Haplic and Calcaric Phaeozems); peat of highest elevations (Dystric Histosols); alluvial soils (Eutric Fluvisols).

**Main land capability classes:** similar to soil region 34.2

**Main soil degradation processes:** similar to soil region 34.2.

### 34.3 - 16.5 Eastern and central Alps on calcareous sedimentary rocks

**Surface:** 19062 km<sup>2</sup>, 6.3% of Italy.

**Climate and pedoclimate:** temperate mountainous; mean annual air temperature: 11-13°C; mean annual precipitation: 690-1200 mm; rainiest months: May and October; dry months: July and August; months with mean temperatures under 0°C: January. Soil moisture regime: udic and perudic; Soil temperature regime: mesic and cryic, locally thermic.

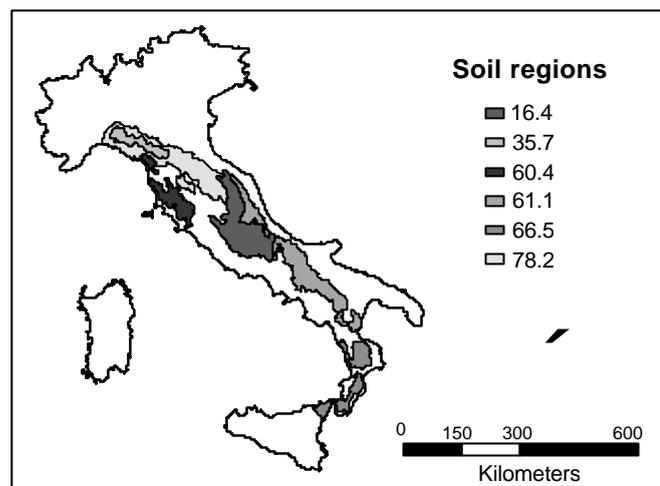
**Geology and morphology:** Tertiary limestone and Mesozoic dolomite, Holocene alluvial deposits. Sloping land with included valleys, mean altitude: 1115 meters a.s.l. (std 540), mean slope: 51% (std 33).

**Main soils:** shallow soils of highest elevations (Lithic Cryosols); ; more or less shallow soils with organic matter accumulation on surface (Lithic, Mollic, Eutric, and Rendzic Leptosols); soils with pedogenetic structure in depth and weakly differentiated profile (Eutric and Calcaric Cambisols); alluvial soils (Eutric Fluvisols).

**Main land capability classes:** similar to soil region 34.2.

**Main soil degradation processes:** similar to soil region 34.2.

## Soil regions of the Apennines



### 35.7 Highest part of northern Apennine

**Surface:** 3668 km<sup>2</sup>, 1.2% of Italy.

**Climate and pedoclimate:** temperate mountainous; mean annual air temperature: 9-10°C; mean annual precipitation: 1500-2000 mm; rainiest months: October and November; dry months: July; months with mean temperatures under 0°C: January. Soil moisture and temperature regime: udic, mesic.

**Geology and morphology:** Tertiary sandstone and marly limestone. Sloping land, mean altitude: 1003 meters a.s.l. (std 305), mean slope: 35% (std 21).

**Main soils:** more or less shallow soils (Umbric and Eutric Leptosols); more or less acid soils with iron oxides and aluminium accumulation (Haplic Podzols; Dystric and Eutric Cambisols).

**Main land capability classes:** 6<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> class soils, with limitations for climate and steep slopes, thickness, stoniness and rockiness, acidity and water and mass erosion.

**Main soil degradation processes:** more than 78% of this soil region is covered by woodland and permanent meadows, while extra-agricultural uses are solely a 0.45%. The extensive use and the scarcity of human presence limit soil degradation to occasional soil water erosion and mass movements. Local

soil acidification has been noticed in chestnut and conifer forests placed on quartzite lithotypes at elevation higher than 900 m.

### 78.2 Northern and central Apennine

**Surface:** 16865 km<sup>2</sup>, 5.5% of Italy.

**Climate and pedoclimate:** temperate warm subcontinental; mean annual air temperature: 9-14°C; mean annual precipitation: 900-1400 mm; rainiest months: October and November; dry months: July and August; months with mean temperatures under 0°C: January. Soil moisture regime: udic, locally xeric or ustic along the coast; soil temperature regime: mesic and termic.

**Geology and morphology:** Tertiary arenaceous marly flysch. Sloping to steep land, mean altitude: 546 meters a.s.l. (std 243), mean slope: 30% (std 21).

**Main soils:** more or less eroded soils (Eutric and Calcaric Regosols; Lithic Leptosols); soils with pedogenetic structure in depth and weakly differentiated profile (Eutric and Calcaric Cambisols); soils with clay accumulation (Haplic and Gleyic Luvisols); acid soils with organic matter accumulation (Humic Umbrisols); soils of anthropic terraces (Anthropic Regosols).

**Main land capability classes:** 4<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> class soils for slope, thickness, stoniness, rockiness and high erosion risk, locally for clayey texture or acidity.

**Main soil degradation processes:** in spite of being covered mainly by forests and permanent meadows, superficial soil erosion and landslides are frequent and interest a large part of the area. Besides natural factors, the spatial incidence of active and quiescent phenomena has been somehow related to i) the destruction of forest cover caused by fire, ii) the abandonment of traditional hydraulic agrarian arrangements, especially of terracing, iii) the diffusion of more intensively cultivated crops and of deep ploughing, iv) the diffusion of excessive land levelling and slope reshaping before specialized tree plantations. The importance of soil erosion in these soil regions is testified by the fact that a large part of agricultural soils have a low or very low organic matter content. In addition to the increase in soil losses, the expansion of the aforementioned practices caused the loss of the traditional landscape constituted by the mixed culture and, in many cases, an impairment of land capability and suitability for qualitative crops.

### 60.4 Anti-Apennines chains of Tuscany

**Surface:** 6373 km<sup>2</sup>, 2.1% of Italy.

**Climate and pedoclimate:** Mediterranean oceanic and suboceanic, partially mountainous; mean annual air temperature: 10-16°C; mean annual precipitation: 750-1600 mm; rainiest months: October and November; dry months: July and August; months with mean temperatures under 0°C: no one. Soil moisture regime: xeric to udic; soil temperature regime: thermic and mesic.

**Geology and morphology:** metamorphic rocks (marble, schist, quartzite), limestone, marl and sandstone, Quaternary igneous rocks. Sloping land, mean altitude: 342 meters a.s.l. (std 252), mean slope: 47% (std 29).

**Main soils:** soils with pedogenetic structure in depth and weakly differentiated profile (Eutric, Calcaric, Chromic, Dystric and Vertic Cambisols); soils rich in iron oxides and clay accumulation (Haplic and Chromic Luvisols); eroded and shallow soils (Eutric and Calcaric Leptosols and Regosols); soils of anthropic terraces (Anthropic Regosols).

**Main land capability classes:** 5<sup>th</sup>, 6<sup>th</sup>, and 7<sup>th</sup> class soils, with limitations for slope, thickness, stoniness, rockiness, acidity and moderate water erosion.

**Main soil degradation processes:** similar to soil region 78.2.

### 16.4 Apennine relieves on limestone and intra-mountain plains

**Surface:** 15288 km<sup>2</sup>, 5% of Italy.

**Climate and pedoclimate:** temperate warm subcontinental; mean annual air temperature: 9-13.5°C; mean annual precipitation: 800-1200 mm; rainiest months: October and November; dry months: July and August; months with mean temperatures under 0°C: January and February. Soil moisture regime: udic, locally xeric or ustic; Soil temperature regime: mesic, locally thermic.

**Geology and morphology:** Mesozoic and Tertiary limestone, dolomite and marl. Sloping land with included valleys, mean altitude: 889 meters a.s.l. (std 464), mean slope: 33% (std 25).

**Main soils:** shallow soils (Eutric and Rendzic Leptosols); soils with pedogenetic structure in depth and weakly differentiated profile (Eutric and Calcaric Cambisols); soils rich in iron oxides and clay accumulation (Haplic and Chromic Luvisols).

**Main land capability classes:** 7<sup>th</sup>, 8<sup>th</sup> class soils, 1<sup>st</sup> and 2<sup>nd</sup> class soils in flat lands; limitations for slope, thickness, stoniness, rockiness and water and mass erosion, locally for clayey texture.

**Main soil degradation processes:** similar to soil region 78.2.

### 61.1 Apennine and anti-Apennines relieves on sedimentary rocks of central and southern Italy

**Surface:** 16577 km<sup>2</sup>, 5.4% of Italy.

**Climate and pedoclimate:** Mediterranean mountainous; mean annual air temperature: 9-14.5°C; mean annual precipitation: 800-1000 mm; rainiest

months: November and January; dry months: July and August; months with mean temperatures under 0°C: no one. Soil moisture regime: xeric to udic; soil temperature regime: mesic, locally thermic.

**Geology and morphology:** Tertiary arenaceous marly flysch. Sloping land with included valleys, mean altitude: 619 meters a.s.l. (std 299), mean slope: 29% (std 21).

**Main soils:** shallow and eroded soils (Eutric and Calcaric Regosols; Lithic Leptosols); soils with pedogenetic structure in depth and weakly differentiated profile (Eutric and Calcaric Cambisols); soils with clay accumulation (Haplic Luvisols), soils on volcanic ashes (Umbric Andosols).

**Main land capability classes:** 3<sup>st</sup> to 7<sup>th</sup> class soils for thickness, stoniness, rockiness, slope, clayey texture and erosion.

**Main soil degradation processes:** similar to soil region 78.2.

### 66.5 Apennine of Calabria and Sicily on igneous and metamorphic rocks

**Surface** 8480 km<sup>2</sup>, 2.8% of Italy.

**Climate and pedoclimate:** Mediterranean mountainous; mean annual air temperature: 12-17°C; mean annual precipitation: 650-1200 mm; rainiest months: January; dry months: June to August; months with mean temperatures under 0°C: no one. Soil moisture regime: udic, locally xeric; soil temperature regime: mesic and thermic.

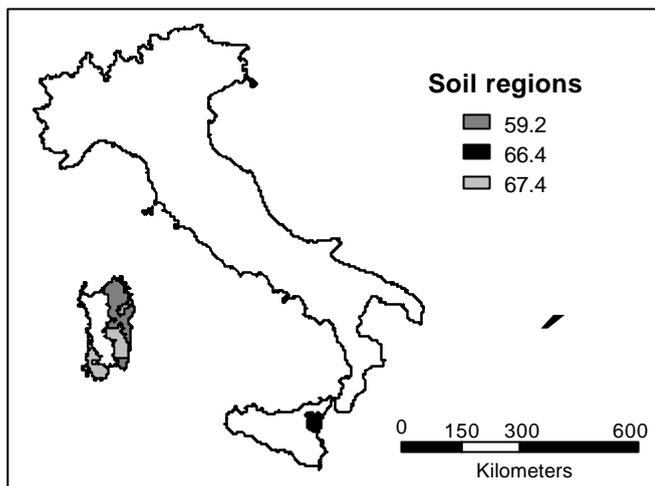
**Geology and morphology:** intrusive igneous and metamorphic rocks. Sloping to steep land with included valleys, mean altitude: 777 meters a.s.l. (std 390), mean slope: 33% (std 21).

**Main soils:** acid soils with organic matter accumulation on surface (Humic Umbrisols; Dystric and Eutric Cambisols); shallow and eroded soils (Dystric and Umbric Leptosols and Regosols); soils with clay accumulation (Haplic and Chromic Luvisols).

**Main land capability classes:** 4<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> class soils, with limitations for slope, rockiness, stoniness and water erosion risk.

**Main soil degradation processes:** the high soil erodibility, due to the peculiar nature of the lithotype, combined with the high energy of the relief and the Mediterranean type of climate, make the risk of soil erosion in this soil region extremely high. In the sixties, catastrophic events of erosion and flooding induced the start of a wide program of reforestation, which reduced the geomorphological risk. Notwithstanding, soil erosion is still a major problem in all the cultivated areas, and it has been noticed a marked decrease in the organic carbon content of agricultural soils, as a consequence of the intensification of husbandry and crop mechanization.

### Soil regions of the Etna and Sardinian mountains



### 66.4 Mountains of Etna

**Surface** 1629 km<sup>2</sup>, 0.5% of Italy.

**Climate and pedoclimate:** Mediterranean and Mediterranean mountainous; mean annual air temperature: 13-18°C; mean annual precipitation: 800-1400 mm; rainiest months: October; dry months: July and August; months with mean temperatures under 0°C: no one. Soil moisture regime: xeric to udic; soil temperature regime: thermic and mesic.

**Geology and morphology:** Tertiary, Quaternary and Mesozoic volcanic extrusive rocks. Sloping land, mean altitude: 816 meters a.s.l. (std 570), mean slope: 16% (std 16).

**Main soils:** soils with pedogenetic structure in depth and weakly differentiated profile (Eutric Regosols and Cambisols); soil with characters from volcanic

materials (Vitric and Silic Andosols); soils of anthropic terraces (Anthropic Regosols).

**Main land capability classes:** soils of all classes, according to slope, stoniness and rockiness.

**Main soil degradation processes:** the region is characterized by high fragility, due to the presence of the major active volcano of Europe and to intensive land use, both agricultural and extra-agricultural. Although the rough morphology, settlements cover to not negligible portion of the territory (almost to 10%) and are continuously threatened by lava effusions and ashes depositions. Bare surfaces are more than 21%. Of the remaining part of the region, woodland and permanent meadows are only 27.6%, while tree intensively cultivated lands get to 39%.

### 59.2 Mountains and hills of Sardinia, on acid crystalline rocks

**Surface** 7323 km<sup>2</sup>, 2.4% of Italy.

**Climate and pedoclimate:** Mediterranean continental and subcontinental; mean annual air temperature: 14-18°C; mean annual precipitation: 600-1200 mm; rainiest months: October and January; dry months: June to September; months with mean temperatures under 0°C: no one. Soil moisture regime: xeric and dry xeric, locally udic; temperature regime: thermic, locally mesic.

**Geology and morphology:** Palaeozoic and Mesozoic intrusive igneous rocks, partially metamorphic, and limestone, with Quaternary alluvial deposits. Sloping to steep land, with enclosed valleys, mean altitude: 387 meters a.s.l. (std 278), mean slope: 12% (std 11).

**Main soils:** shallow soils (Eutric, Lithic and Dystric Leptosols); soils with pedogenetic structure in depth and weakly differentiated profile (Eutric, Vertic and Dystric Cambisols); alluvial soils (Eutric Fluvisols).

**Main land capability classes:** 2<sup>nd</sup> and 4<sup>th</sup> class soils in cultivated lands, 7<sup>th</sup> and 8<sup>th</sup> in grazing and forestry lands, for thickness, high erosion risk, slope, stoniness and rockiness, drought, acidity.

**Main soil degradation processes:** these are the soil regions of Italy with the maximum degree of degradation. The incidence of pastures and woodlands is around 62.5%, but it has been estimated that more than 50% of the pastures are desertified because the long-lasting sheep overgrazing and the succession of fires. Moreover, 24.3% of the soil regions is utilized with tree cultivation, which in large part is constituted by cork oak (*Quercus Suber*) and other species which are as well pastured and prone to soil compaction, soil erosion and organic matter reduction, caused by agricultural practices and repeated use of fire for clearing pasture areas. Another major cause of soil degradation is heavy metal contamination of soils in active and in no more active mining areas. Occurrences have been reported about eroded sediments from flotation and waste dumps which were deposited on soils of the underlying valleys.

### 67.4 Mountains and hills of Sardinia on metamorphic rocks

**Surface** 6548 km<sup>2</sup>, 2.1 % of Italy.

**Climate and pedoclimate:** Mediterranean subcontinental and continental; mean annual air temperature: 14-18°C; mean annual precipitation: 600-1200 mm; rainiest months: October and January; dry months: July and August; months with mean temperatures under 0°C: no one. Soil moisture regime: xeric, thermic.

**Geology and morphology:** Palaeozoic metamorphic rocks. Sloping to steep land, mean altitude: 437 meters a.s.l. (std 314), mean slope: 23% (std 19).

**Main soils:** shallow soils (Eutric, Lithic and Dystric Leptosols); more or less acid soils with pedogenetic structure in depth and weakly differentiated profile or with accumulation of organic matter. (Eutric and Dystric Cambisols; Humic Umbrisols).

**Main land capability classes:** similar to soil region 59.2.

**Main soil degradation processes:** similar to soil region 59.2.

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