the soil, the earth's skin

"Beneath the earth on which we tread, the eyes of seven generations watch us, waiting to inhabit the earth. That is why we must tread lightly".

Native American Indian saying

The soil we tread upon is a natural living thing, produced by complex interaction between geology, climate, vegetation, life forms (including Man) and time. Its cycle of formation and evolution involves extremely variable time scales, from tens of thousands of years to just a few months, and determines the weathering and fragmentation of rocks and the formation and transformation of organic matter through chemical, physical and biological processes. The soil consists of mineral particles (sand, silt and clay), decomposed organic substances (humus), living organisms, air and water. It can vary in depth from a few centimetres to a number of metres, divided into horizons or strata that can be distinguished from the source material (rock or sediment). Soil formation is therefore the result of processes of addition, loss, transfer and transformation of energy and matter.

The name given to the combination of all these processes which results in the formation of the soil is pedogenesis; the term pedology, meanwhile, is the science that studies soils.

The soil is the living skin of the earth, through which the lithosphere, hydrosphere, atmosphere and biosphere interact. It plays a vital role in the life of our planet because it regulates the water, carbon, phosphor and nitrogen cycles. The soil is a resource which is largely non-renewable; it is sensitive to the effects of climate change and human activity. This precious resource serves vital purposes:

- productive: the roots of nearly all the earth's vegetation are found in the soil, from which they draw nourishment and water
- regulating: the characteristics of a given soil influence the movement of water within the soil (hydrologic cycle), the transportation of solid particles and soil erosion.
- protective: the soil is a biological filter, capable of capturing pollutants and protecting surface groundwater resources and the food chain.
- naturalistic: it represents a major biodiversity reserve because it forms the habitat richest in plant and animal organisms.
- climatic: it plays an important role in the carbon cycle, influencing the energy balance of the earth's surface and the climate.
- settlement: it supports buildings, urban infrastructure and distribution networks and is the source of raw materials such as clay, sand and gravel.
- historic-environmental: it provides us with evidence of environmental changes and changes in the history of man.

whose work involves the soil

Soil survey and database administration

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www.regione.emilia-romagna.it/cartpedo

Application and sharing of soil data within the agricultural sector

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Viale Silvani, 6 - 40122 Bologna
Tel. 051 284451 - Fax 051 284524
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Soil monitoring

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Chemical-physical analysis of soil

ARPA - Dipartimento tecnico
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Tel. 0544 210611 - Fax 0544 210650

Soil maps:

Archivio cartografico regionale - Via dello Scalo 3/2 - Bologna - Tel. 051 6493230 - Fax 051 5280042
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2005

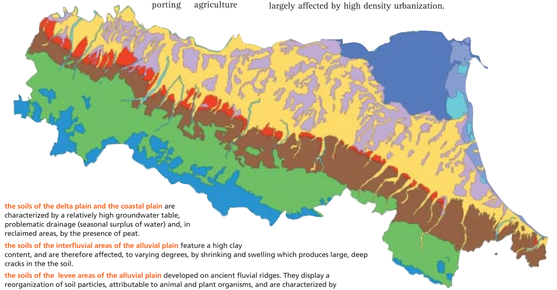
the soil

The lands of Emilia-Romagna

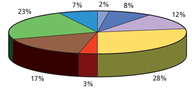
RegioneEmiliaRomagna

The lands of Emilia-Romagna

Eight main soil groups have been identified in Emilia-Romagna, attributable to as many land units characterized by different geology, climate and morphology. Within these environments the processes that constitute contributing factors in soil formation have manifested themselves in different ways and to varying extents, producing soils with specific properties and uses. The soils of the alluvial plain are extremely fertile, supporting agriculture and the production of crops whose quality and typical characteristics are acknowledged internationally. In the mountains the soils are characterized by a high degree of variability and are used for agriculture, with fruit orchards and vineyards, as well as for forestry and grazing. The soils of the coastal environment, in the morphologically surveyed areas of the alluvial plain and along the Apennine margin, are, on the other hand, largely affected by high density urbanization.



- the soils of the delta plain and the coastal plain are characterized by a relatively high groundwater table, problematic drainage (seasonal surplus of water) and, in reclaimed areas, by the presence of peat.
- the soils of the interfluvial areas of the alluvial plain feature a high clay content, and are therefore affected, to varying degrees, by shrinking and swelling which produces large, deep cracks in the the soil.
- the soils of the levee areas of the alluvial plain developed on ancient fluvial ridges. They display a reorganization of soil particles, attributable to animal and plant organisms, and are characterized by deposition at depth of calcium carbonate, leached from the surface by the water.
- the soils of the Apenninic margin are ancient soils which began to form on fluvial terraces over 100,000 years ago. They are characterized by a marked difference between horizons. Their formation occurred largely under different climatic conditions than those we experience today, which facilitated the removal of carbonates and the formation of the iron oxide responsible for the often reddish hue of the soils.
- the soils of the lower Apennines are affected by a reorganization of soil particles, attributable to animal and plant organisms, and by poorly developed processes of mobilization and redeposition at depth of calcium carbonate.
- the soils of the mid Apennines, compared to those of the lower Apennines, feature greater loss of calcium carbonate, locally displaying moderate acidification due to a sequence of copious rainfall in autumn-spring followed by brief periods of drought in summer.
- the soils of the upper Apennines formed under conditions of low temperatures and rainfall values generally higher than evapotranspiration rates: these conditions slowed down the decomposition of organic matter and favoured the development of an acidifying action. These soils, typically dark brown to ochre in colour, feature marked variations in the soil profile.



Emilia-Romagna Region, *Soil Map*, 1994

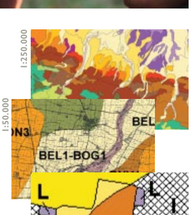
survey, cartography and database

The study of soils entails, first and foremost, the identification of portions of land that are homogeneous in terms of climate, geology, morphology and soil use, through the analysis of aerial photographs and satellite images. The next step is to survey the land by excavating profiles at least 1.5 metres deep, or making bore holes. Field observations enable the soil scientist to record vital information on each layer (horizon) of the soil, including the texture (evaluation of the sand, silt and clay content), the presence of calcium, the pH and colour. This data is generally integrated with laboratory analysis carried out on soil samples.

Soil surveying in Emilia-Romagna began in 1976 and mapping has been carried out on three scales. Data processing has enabled the SSGS to produce cartography, today available in both printed and digital formats. The soil map to scale 1:250,000 gives the broadest overview of the soils of the region, the map to scale 1:50,000 describes the main soils of the plain and of a number of sample zones in the hill and mountain areas. The map to scale 1:10,000 is used to provide a detailed description of the distribution of soils in some experimental farms.

The information, at the various levels of detail, is cohesive and complementary, enabling "change of scale" during data processing from the detailed to the general and vice versa. The cartography can be consulted on the Internet, along with the description of the main soil types found on the Emilia-Romagna plain, their agronomic behaviour and some considerations on their agricultural use. The updating of the soil map, which is an ongoing task, is carried out in conjunction with those who make use of the soil data, namely the regional and provincial Services operating in the agro-forestry, environmental and soil defence sector, the Land Reclamation Consortiums and the River Basin Authorities. This synergy makes it possible to assess and share evaluations on the behaviour of the soil and formulate management strategies.

Soil data is stored in a database originally set up in the early 1980s. The soils database is currently structured as a territorial computerized system containing numerous inter-related alphanumeric (database) and geographic (GIS) archives. The database contains details on approximately 25,000 sample points carried out for soil mapping purposes, plus data obtained from laboratory analysis (chemical, physical, mineralogical, micro-morphological).



In addition to the main body of information concerning the soils, the database also contains archives of data provided by other organizations, in particular by the Servizio Sviluppo Sistema Agroalimentare dell'Assessorato Agricoltura (Food and Agricultural System Development Service), with which the SGSS has been working closely for a number of years.

These archives contain:

- approximately 58,000 geo-referenced chemical-physical analyses;
- agronomic experiments carried out on farms where physical-hydrological measurements are taken and agronomic trials performed on representative soils;
- measurements, carried out by Land Reclamation Consortiums and Provincial authorities, of the level of the subsurface phreatic water table: that is to say, the water table found in the uppermost 2-3 metres of the earth's surface.

www.regione.emilia-romagna.it/cartpedo
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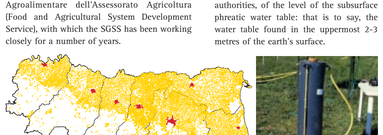
Vittorio Tadini experimental farm



Regional distribution of soil sampling points.
Right: monitoring station for surface infiltration

a resource to protect

The soil, as affirmed by European Commission communication 179/2002, "performs a number of key environmental, social and economic functions vital for life" and is today threatened by phenomena and processes linked predominantly to human activity which can result in the loss of soil function and ultimately the loss of soil itself. The main threats facing soils in Europe are: erosion, contamination, loss or organic matter and sealing.

Decrease of organic matter content

Sealing

In Emilia-Romagna approximately 35% of agricultural soils of the hill and mountain areas is affected by erosion. The gravest situations are due to the presence of erodible soils, intense precipitation with strong erosive capacity and crops offering poor cover. The risk of contamination affects the soils of the Emilia-Romagna plain above all, where the main industrial facilities and waste dumps are concentrated (local contamination). Moreover, the plain is at greater risk from contamination linked to excessive agricultural use of chemical substances (fertilizers and phyto-pharmaceuticals) and from disposal of wastewater sludge (diffuse soil contamination).

Erosion

Contamination

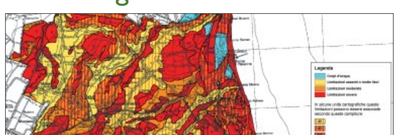
This can cause toxicity and pollution with adverse repercussions on the food chain and the quality of surface and groundwaters. The soils present in some areas of the plain run the risk of decline in organic matter because of changed agronomic practices. In Emilia-Romagna the organic matter content of soils, with the exception of the reclaimed areas in the province of Ferrara, is medium-low (2%); lower values still characterize the plain in Bologna, Romagna and in parts of Ferrara. Lastly urbanization, which affects large areas of the regional territory, is another threat, changing water flow patterns. This phenomenon, known as sealing, affects agricultural areas of the plain and the hill territory, and lead to a 70% increase in built-up areas between 1976 and 1994.

> *"Soil is a vital and largely non-renewable resource, increasingly under pressure. For sustainable development, it needs to be protected."*
>
> European Commission, *Towards a thematic strategy for soil protection*, Communication 179/2002

"Soil is a vital and largely non-renewable resource, increasingly under pressure. For sustainable development, it needs to be protected." European Commission, Towards a thematic strategy for soil protection, Communication 179/2002

toward correct soil management

At the Earth Summit on sustainable development held in Rio de Janeiro in 1992, the international community acknowledged the indispensable role of soil for human life. Ten years later the European Commission, with Communication n. 179, provided a framework for developing national and regional policy on the protection of soil. In 1997 Emilia-Romagna regional authority introduced a series of specific regulations aimed at improving soil awareness, enhancing the potential and preserving the quality of soil.
With legislation introduced in 2000-2001 the Regional authority gave top priority to the preservation of agricultural soils, launching a series of measures to support farming methods with low environmental impact, preserve natural spaces and biodiversity. Another tool introduced was regional law 25/2000 for the preservation of the production potential of agricultural soils and the prevention of soil decline and environmental pollution. The authority thus strived to promote the adoption of suitable soil management strategies and proper use of organic fertilizers, soil improvers and livestock effluents.
It is within this context that the Geological, Seismic and Soil Survey is involved in a series of experimental activities aimed at expanding the knowledge base necessary for correct soil management. The focus is on both critical threats to soil such as erosion, the scale of which is being evaluated in order to identify measures to be taken to control it, and on the enhancement of the characteristics of soils, through the compilation of soil suitability maps for different crops and agricultural products, carried out together with technicians of the agro-forestry sector. To support good farming practices, monitoring of the physical and biological qualities of soils is carried out in order to evaluate the effects of the use of organic soil improver on organic matter content, on the fertility of arable land and the quality of crops. To support water protection plans and the agronomic use of organic waste, improvements have been made to soil description and behaviour evaluation techniques, which are used to compile groundwater vulnerability maps. The aim of the project studying current and background content of heavy metals is to assess any risk of contamination of soils and surface and/or groundwaters. The map of soil organic matter content, produced to regional scale, is the reference document for projects on the role of the soil in the carbon cycle (1997Kyoto protocol) and the evolution of organic matter over time.



Soil suitability for pear cropping on the Ravenna alluvial plain

Municipality of Cesena. *Left* the current risk situation with regard to soil erosion by water, *right* the potential situation after soil conservation measures

le principali normative regionali

Deliberation n. 570 of the Regional Council, 11th February 1997. Approval of the Regional Territorial Plan for the protection and improvement of water - Abridged plan for the zootechnical sector

Regional law 24 March 2000, n. 20
General discipline on territorial protection and use

Regional law 7 April 2000, n. 25
Encouragement of the use of organic fertilizers in order to safeguard the quality of agricultural soils

Regional law 30 January 2001, n. 2
Putting into effect of regional rural development plan of Emilia-Romagna Region 2000-2006