CHAPTER 8

SOIL AND LAND

Soil provides the necessary elements to sustain human societies, but it is too often exploited or used only as a container of production waste. There is a limited awareness of the effects caused by the loss of its functions.

Introduction

Soil is essential for the existence of living species on our planet and carries out a series of functions making it essential for maintaining the environmental balance. Despite this, it is too often perceived only in terms of support to agricultural production and as a physical base on which to develop human activities.

Soil plays a primary role in: protecting underground waters from pollution; controlling the quantity of atmospheric CO_2; regulating surface water flows producing direct effects on floods and landslides; maintaining biodiversity; nutritional element cycles, etc. Plant biomass depends on the soil's conditions with evident consequences on the whole food chain.

Soil, as an extraordinarily differentiated biological laboratory, can be considered a complex living body that continually evolves and that, under certain aspects, is far from being well known. It supplies human beings with the necessary elements for their sustenance, nevertheless it is also a non-renewable and extremely fragile resource. It is too often treated as a container for production waste or as a means of exploitation. There is a limited awareness of the effects deriving from the loss of its functions.

Soil can be affected by serious degradation processes caused by: incorrect agricultural practices; concrete and asphalt sealing, particularly on densely populated areas and where economic activities and infrastructures are concentrated; variations in its utilization and the local effects of global climate change. These processes limit or totally inhibit its functions and often can be highlighted only when they are irreversible or at such an advanced stage that recovery is extremely difficult and economically inconvenient.

This resource must therefore be protected and used in an adequate way, in harmony with its intrinsic properties so that it can continue to carry out its irreplaceable and effective function on our planet.

The situation in Italy

Currently, there is a good knowledge on land use in Italy but soil data are still rather heterogeneous.

An important asset to understand soil-related factors, processes and services is to implement sustainable development and land planning policies. This strategy might be performed by combining socio-economic needs and require-

ments, also in terms of safety, with a cautious and respectful management of the natural heritage and its associated resources. Still, in Italy available information should necessarily be improved to give a thorough and harmonised outline of soil use and information.

In Italy information on soil has a long history but it is only from the 1990s that many Italian regions started to systematically collect data on soil and produce maps and databases. Despite the large amount of data on soil collected, even if not equally distributed, the information is rather heterogeneous and in many cases limits the possibility of making organic syntheses throughout the country. To try and resolve this situation, projects for harmonising soil regional information have been established. Most of the data provided below should therefore be considered approximate. They will represent the national situation but no sooner they have been completed.

Organic carbon (OC), which accounts for approximately 60% of soil organic matter, carries out an essential positive function on many soil properties. It facilitates the aggregation and stability of soil particles reducing erosion, compression, cracking and the formation of surface crusts. Organic carbon binds effectively with various substances, improving soil fertility and its control capacity and increasing microbial activity. It also makes nutritional elements, such as nitrogen and phosphorus, available to plants. Knowing the amount of OC stored in Italian soils is therefore an important element to determine their condition.

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For example, as far as farmland is concerned, depending on the nature of soils and climate areas in Italy, an average 2% level of OC can be considered sufficient to guarantee a soil high performance in supplying plants with nutritional elements and performing many other more important functions. Furthermore, even if the amount of carbon contained in soil and vegetation is lower than that of oceans and fossils, the role of soils is still considered more important, even because they are directly influenced by human action. Knowing the OC content stored in Italian soils is the starting point to establish the role these soils can play in reducing greenhouse gas emissions.

Figure 8.1 shows the national distribution of organic carbon in percentage into the first 30 cm of soil. The map was accomplished using data from the Italian Ecopedological Map integrated, where necessary, with those of the European Soil Database. The situation shown by the map raises some concern: about 80% of Italian soils have a presence of OC lower than 2%, while the "high" OC content class practically does not exist on the Italian territory, at least according to this reference scale. The spatial distribution traces the climatic one, with an increase in the "medium" content class in the North of Italy and along the main mountain ridges. At an higher resolution, however, the first regional maps realised within SIAS project (*Sviluppo di Indicatori Ambientali sul Suolo* - Development of Soil Environmental Indicators) framework, show an improved situation, at least in some areas of the country (Figure 8.1a).

The map was accomplished on the basis of available national data and shows how most Italian soils have low levels of organic carbon especially in farmland. However, preliminary data from the SIAS project show an improved situation in some areas.

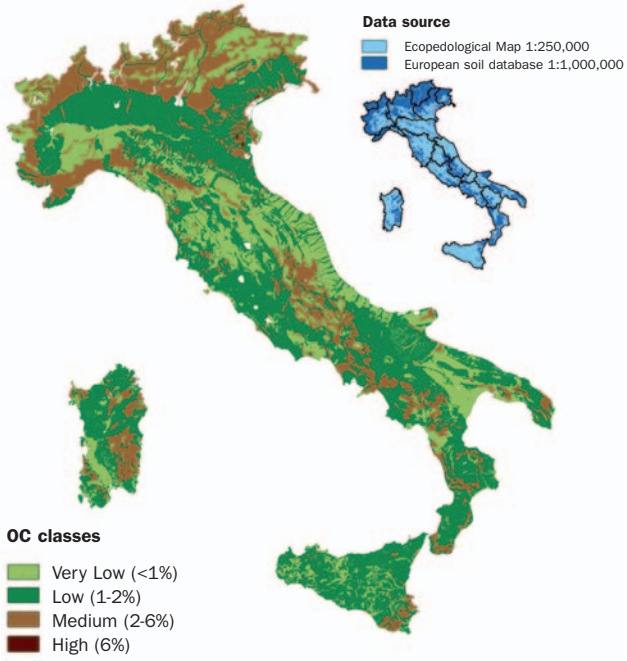

Figure 8.1: Percentage of OC in the topsoil layers of Italian soils (1988-2003)[1]

[1] Source: JRC and MATTM data processed by ISPRA

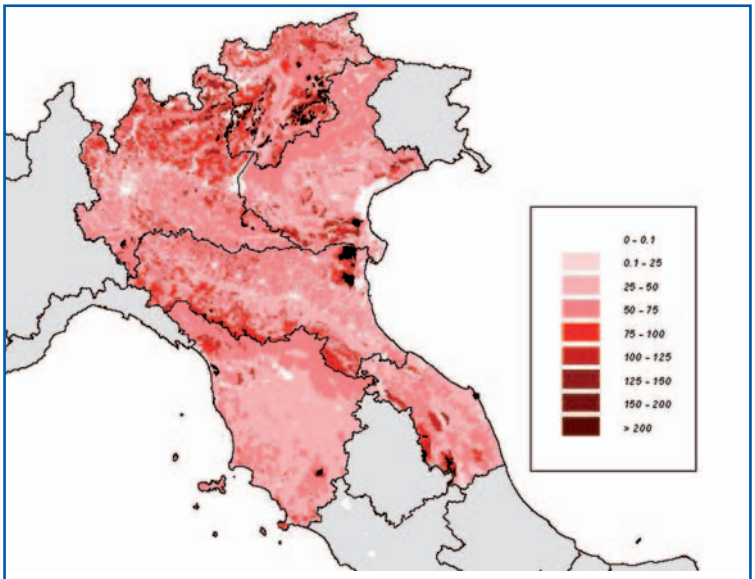

Figure 8.1a: OC content (tons/ha) in the topsoil layers (0-30 cm) of Italian soils (2008)[2]

Soil plays a key role in protecting the environment by mitigating of the negative effects of pollutants.

Soil plays a fundamental function in protecting the environment, serving as a filter and a barrier, so as to mitigate the effect of pollutant dispersion. Soil, if heavily contaminated by hazardous substances, may lose its intrinsic properties to such a level that not only its protective functions, but also its productive and ecological functions are degraded.

Impacts caused by soil contamination also involve surface and underground waters, the atmosphere and the food chain creating serious risks even human health. The economic consequences are mainly related to the need to allocate substantial financial resources for the soil's environmental reclamation and recovery. But they are also related to the value loss of contaminated areas and the need to intervene on environmental matrices that are indirectly affected by the impacts of soil contamination (particularly underground waters). An impact evaluation (SEC (2006)1165)

[2] Source: ISPRA and Regional Soil Services (SIAS Project)

related to the Thematic Strategy for Soil Protection (COM (2006) 231), performed by the European Commission, estimated that the annual cost of soil contamination ranges between 2.4-17.3 billion Euro.

Soil contamination may impact on limited areas (contaminated sites) or it can affect extensive areas (diffuse contamination).

Soil contamination may impact on limited and well defined areas, corresponding to known point sources (contaminated sites), or it can affect extensive areas by release into the environment of large quantities of polluting substances from multiple sources dispersed throughout the territory (diffuse contamination).

In Italy there are 57 contaminated Sites of National Interest. The Ministry for the Environment, Land and Sea coordinates restoration directly.

At present, in Italian national territory, 57 contaminated Sites of National Interest have been located (SIN, Figure 8.2). These sites were identified by issue of specific decrees a on the basis of the site characteristics, quantity and level of danger of the polluting substances, plus the magnitude of health and ecological risks and the detrimental effects on cultural and environmental resources. The restoration efforts of these sites are directly coordinated by the Ministry of the Environment, Land and Sea, which draws on the services of the ISPRA for the assessment of site characterization and remediation projects, as well as Regional and Provincial Environmental Agencies and the National Institute of Health (ISS).

Sites of National Interest are concentrated in areas subject to high authropogenic impact (active or abandoned industrial areas, port areas, dumps, extraction areas, etc.).

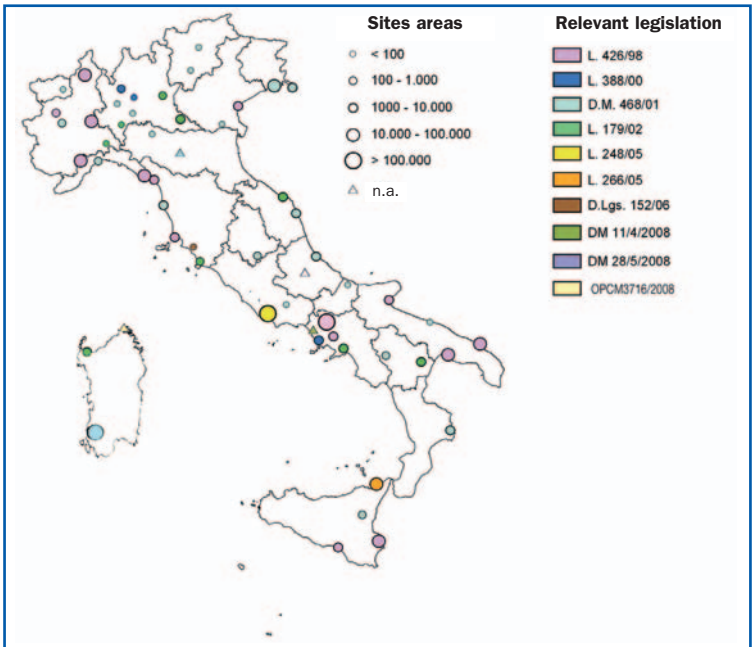

Figure 8.2: Localisation, dimensions and relevant legislation on Sites of National Interest (2008)[3]

Some Sites of National Interest are particularly extensive (e.g. the Domizio-Flegreo Littoral, Agro Aversano area and the Sulcis-Iglesiente-Guspinese site) and/or characterised by historical contamination levels of soil and groundwater (e.g. Porto Marghera). In these cases, implementation of actions for full site recovery over the medium-short term (25 years) is a difficult objective in technical, economic and environmental terms. For this reason, some of them are called "megasites". In addition to Sites of National Interest, there are several other thousands of contaminated or potentially contaminated sites falling under regional responsibility, and which, based on the legislation currently in force, should be included in special "Regional Registries of Sites to be Restored". A separate topic is that of *brownfield*. These are abandoned, inactive or underused sites which have hosted productive facilities,

There are about 15,000 potentially contaminated sites, of which more than 4,000 need to be reclaimed. These fall under the responsibility of regional authorities.

[3] Source: ISPRA

generally industrial or commercial. Their utilization is hindered by a real or potential condition of historical pollution. These sites are often located inside urban land and therefore have a high economic potential. In Italy, the regions with the highest number of brownfields are in the North, particularly in the regions of Lombardy, Piedmont and Veneto which experienced the highest industrial development in the past decades. The Centre and South of Italy is characterised, instead, by few but extensive industrial areas. These have witnessed concentrated development in a limited number of areas.

Cases of diffuse contamination are found in almost every region but Italy still lacks a uniform national scale framework.

A national homogeneous overview of diffuse soil contamination is not yet available, even though the related problems are present in almost all Italian regions. Accumulations of heavy metals in soil have been reported near road infrastructures (Pb), in wine-producing districts (Cu) and intensive farming areas. Soils contaminated by organic compounds are found near industrial areas, particularly in the Campania region where pollution by PCBs, furans and toxins is a very serious problem. As regards pollution by nitrates, available data show a surplus of nitrogen and of phosphorous in almost all Italian regions. However, these have a progressively reducing trend. The highest levels are found in intensive farming areas, particularly in some regions of the Po River Plain.

Erosion by water produces loss of soil, fertility and biodiversity.

Another issue of great environmental and economic relevance is the phenomenon of soil erosion by water (i.e. the removal of topsoil, rich in organic matter, by surface waters). Damages caused by erosion are distinguished as on-site and off-site damages. On-site damages are generally classified as damages that occur in the same place where the phenomenon takes place, which lead to loss of soil, fertility, biodiversity, etc. Off-site damages occur far from where the erosion phenomenon takes place, causing floods, damages to infrastructures, contamination of surface waters (due to transport of pollutants by surface water runoff), etc. Limiting these damages in many cases requires corrective operations especially in highly prestigious farmlands, economically relevant ones or, in any case, in areas where the erosion tolerance rate (factor T) exceeds the provided standards. The erosion tolerance rate (expressed in tons/hectare/year) enables a controlled productive and protective use of the soil. It

should therefore be generally lower with respect to the soil formation speed (pedogenesis). Assessment of soil loss is carried out by using empirical models (e.g. USLE – Universal Soil Loss Equation) and physically-based ones (e.g. PESERA – Pan European Soil Erosion Risk Assessment). The models show that in about 30% of Italian soils the erosion risk is higher than the allowed values. These national-scale estimates, realised by means of models, are only based on approximate data. There are still few experimental stations that directly measure this process and would be able to validate the results obtained. However, a national framework of reference showing the actual situation, based on data collected at local level, is currently being finalised under the above mentioned SIAS project. Regional information is being harmonized in accordance with criteria provided under the INSPIRE Directive. The project is coordinated by ISPRA in collaboration with the CRA, JRC-IES and Italian regions.

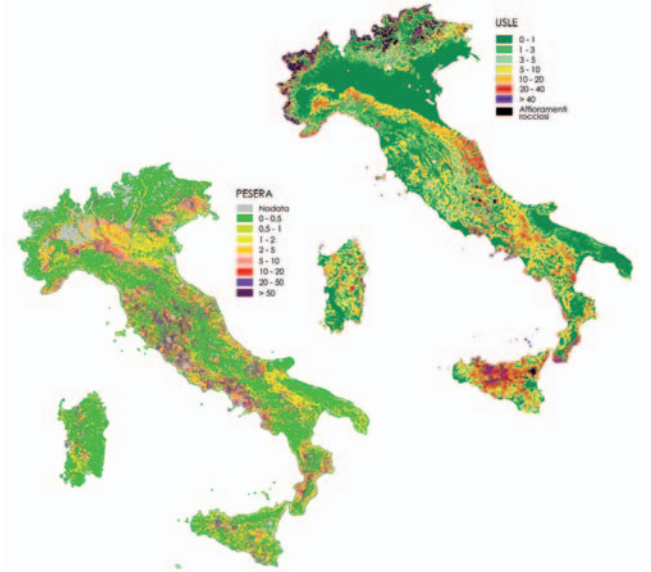

Figure 8.3: Actual erosion risk assessment (t* ha^{-1}* year^{-1}) according to USLE (1999) and PESERA (2004) models[4]

Loss of soil by water erosion is usually assessed by means of models. Although these estimates offer interesting information at national scale, they are affected by simplifications carried out when defining environmental parameters. Therefore, in some cases, their results can be substantially different from regional ones.

[4] Source: JRC - IES

Salinization is the accumulation of salts in soil in quantities that can compromise its vital functions.

A particularly common phenomenon, especially in the coastal areas, is soil salinization. This refers to an excess of salts in soil, due to natural and human causes. It can reach levels that can compromise vegetation and farming activities causing negative effects on the soil's biodiversity and on its resistance to erosion. The phenomenon is considered one of the main factors that lead to desertification. The JRC-IES (Joint Research Centre-Institute for Environment and Sustainability) estimates that in Europe (EU27) between 1 and 3 million hectares of land are affected by this threats (Figure 8.4).

A national map indicating the extent and characteristics of salt-affected soils is still not available but a lot of information has been collected by Universities and regional soil services. A first survey at national scale was recently carried out by the University of Palermo. It highlighted that salt-affected soils are mainly

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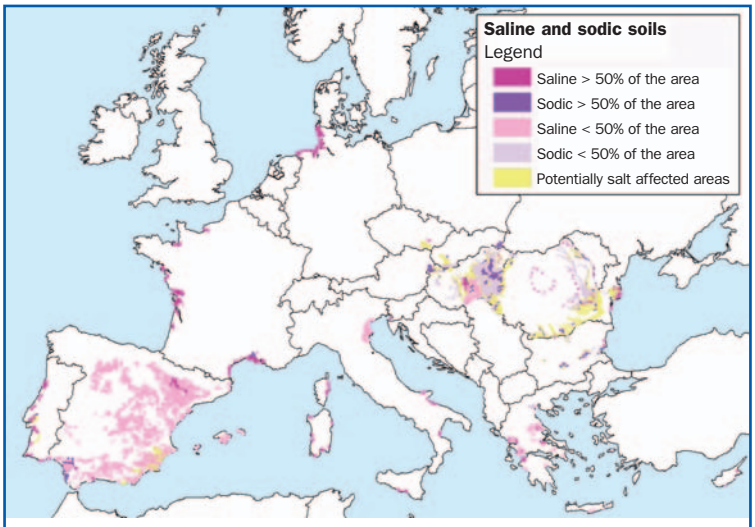

Figure 8.4: Distribution of salt affected soils in the European Union (2008)[5]

[5] Source: Tóth *et al.* (2008) *Updated Map of Salt Affected Soils in the European Union*. In: Tóth G., Montanarella L. and Rusco E.(Eds.), *Threats to Soil Quality in Europe EUR 23438* – Scientific and Technical Research series Luxembourg: Office for Official Publications of the European Communities p.61-74

located in the lower Po River Plain, along extensive Tyrrhenian and Adriatic coastal strips and on the coasts of Apulia, Basilicata and Sardinia. Sicily is worth mentioning on its own, since the problem of salinization involves 10% of its regional land (Figure 8.5).

Soil salinization affects a large portion of Italian coastal areas and is particularly developed in Sicily due to the concomitant presence of natural and human causes.

Figure 8.5: Distribution of salt-affected soils in Italy (red areas)[6]

Areas characterized by intensive farming can be prone to soil compaction process. Compaction, which is mainly due to the use of agricultural machinery, occurs when soil particles are pressed together, reducing the pore space between them. This induces important changes in the soil's structural properties and behaviour, such as the temperature and moisture regimes, the balance and the liquid and gas phases that form the soil. Apart from the topsoil, layer, compaction is also frequently formed at the depth of cultivation (plough sole). The result is not only the reduction of soil functions but also a drastic reduction of water infiltration with subsequent runoff increase.

Soil compaction is considered an important factor in the great floods that have affected different European countries.

[6] Source: C. Dazzi, (2007), *La salinizzazione.* In: Il suolo, la radice della vita. APAT

During intense and concentrated rainfall, there is frequent submersion of plain lands and superficial landslides near compacted layers of soil. This highlights that the problem is common in Italian farming areas, both plain and hilly. Quantitative data are very few and limited to some analysed areas. The only national map that is available regards the natural susceptibility of soils to compaction. It was edit by JRC-IES but does not provide information on the actual extent of the problem (Figure 8.6). At european level, compaction is considered an important factor of the great floods that have affected Northern Europe in the recent past. At national level, there is

Most Italian soils have a medium-high susceptibility to compaction. However, more detailed studies are required to asses the actual extent of the problem and its influence on the recent floods that have occurred in Italy.

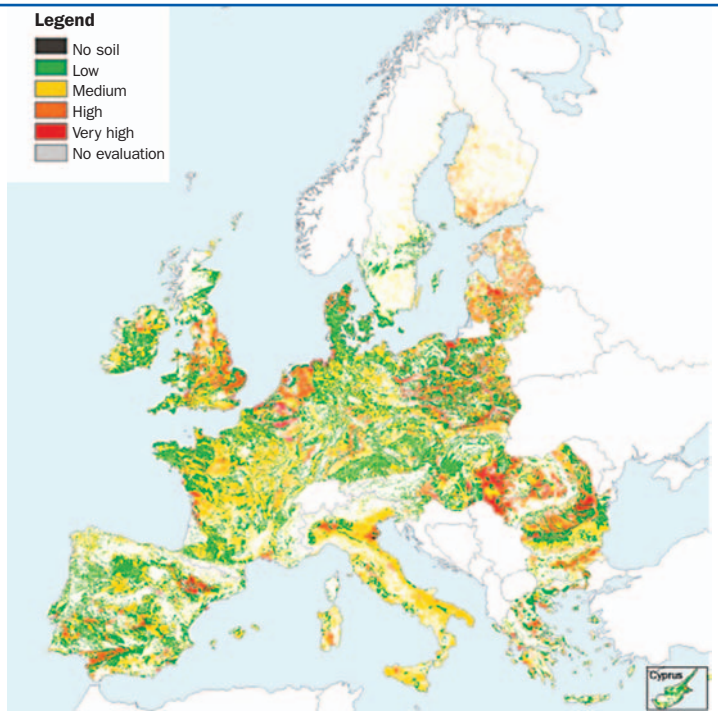

Figure 8.6: European soil compaction susceptibility (2007)[7]

[7] Source: JRC -IES

a lack of studies on the actual effect of compaction on the flooding of Italy's main river floods.

The problem of soil loss due to urbanization is a particularly serious one and a matter of concern since it strongly compromises large areas of land, which are often characterised by soils with a high agricultural value. Soil that has been sealed for urban areas and infrastructures looses many of its ecological functions, some of which become practically irreversible. Comparing between CORINE Land Cover data sets (1990 and 2000) has led to the identification of a trend in land use , even though the minimum mapping unit limit of 25 ha does not clearly show the development of scattered urban centres and of the minor road network. This highlighted that in Italy there is a progressive reduction of areas destined for agricultural use (-1.6 %), a recovery of forest or semi-natural soils (+1.0 %) and an increase of urbanized areas (+0.6 %). On the coast, urban areas have increased, especially in Sardinia and Calabria. Italy, like the rest of Europe, is reducing agricultural land due to the effects of contrasting cultural abandonment and urbanization processes, with a progressive trend towards reduced and more specialised farming areas cultivated following the mixed traditional regime. Forest and especially urban areas, instead, have an expanding trend with an increased variety of use.

Between 1990 and 2000, agricultural areas reduced by 1.6%, in favour of forest or semi-natural areas (1%) and urbanized ones (0.6%).

Soil sealing, is the result of covering the soil with impervious materials, which partially or totally prevent it from performing its vital functions. The issue primarily concerns built-up areas, where the largest surfaces covered by buildings may be found, and areas covered by industrial plants, commercial buildings and transport infrastructures, but similar effects may also be observed in intensive farmland areas, due to the formation of compacted layers of soil, or in areas predominantly used for greenhouse farming or covered with plastic mulch films. These impervious layers form a vertical barrier between the pedosphere, the atmosphere and the hydrosphere. Soil sealing limits/prevents water infiltration and the soil/subsoil's function of retaining the same, thus increasing the event of flash floods.

Soil sealing prevents infiltration of meteoric water and is a factor of floods.

The highest percentages of sealed areas are located near urban areas, near the main road axes and along the coast.

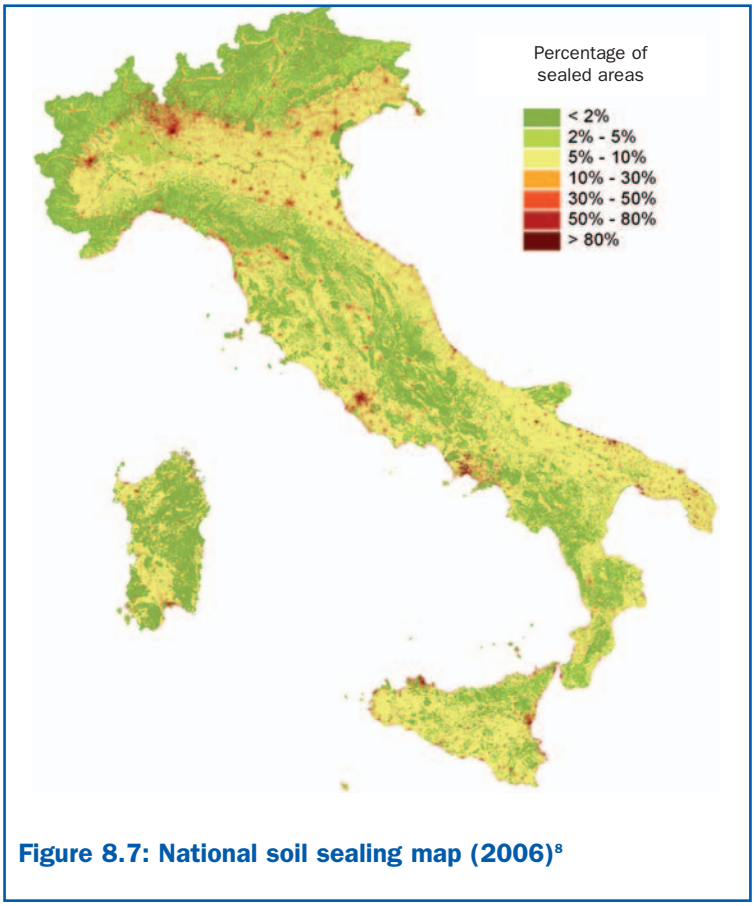

Figure 8.7: National soil sealing map (2006)[8]

The national map of sealed areas due to urbanization (Figure 8.7) is based on data from CORINE Land Cover 2000, and shows that the highest values of this problem are found in Lombardy, Apulia, Veneto and Campania with higher concentrations near urban areas and along the main road axes. In particular, the problem is assuming worrying proportions in the large plain areas, where urbanization is coupled with intensive farming.

[8] Source: ISPRA

Progressive loss of soil biodiversity is due to all the above mentioned factors.

Soil is a very complicated environmental matrix, providing *habitat* for a huge number of organisms. In the intricate three-dimensional matrix of soil, these organisms interact with each other within a very dense food web, giving life to a very complicated system of biological activities.

Soil dwelling organism play an essential environmental role, yet only a very small percentage of species is known.

These organisms actively contribute to providing various services that are critical to the ecosystem, such as: soil formation and water and nutrients retention capacity; decomposition of organic matter and therefore availability of elements contained therein; nitrogen fixation and carbon sink; suppression or induction of parasites and plant diseases and reclamation of soil through biological processes (bioremediation) of contaminated and degraded soil (by means of contaminant detoxication and recovery of physical, chemical and biological properties and processes). Despite their importance, only a very small percentage of organisms living in soil has been identified and classified so far.

A census highlights that, compared to all other European countries, Italy hosts the highest number of soil invertebrates. This is summarised in the table below which shows the number of Italian arthropod families and species. Currently, due to the absence of a specific monitoring network, their exact distribution and the intensity of their populations has still not been identified. Areas subject to soil biodiversity loss in Italy mainly correspond to areas that are affected by previously described threats. Recent surveys have shown that inside protected areas there is a very high quantity of edaphic organisms.

Compared to all other European countries, Italy hosts the highest number of soil invertebrates.

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Table 8.1: Number of Italian arthropod families and species, highlighting classes more related to soil[9]

Classes	Families	Species
Arachnida	351	4,618
Symphyla	2	19
Pauropoda	3	43
Chilopoda	11	155
Diplopoda	28	473
Protura	6	31
Diplura	5	76
Collembola	18	419
Insecta	623	36,853

Desertification is a global process, but it has specific characteristics according to the different ecosystems. In its most extreme forms, it concerns over 100 countries threatening the survival of more than 1 billion people. Overexploitation, unsustainable management of soil resources and climate conditions contribute to increasing the environment's vulnerability to desertification. This phenomenon does not only occur in arid, semi-arid and dry subhumid areas of the earth but also in other parts which are prone to chemical pollution, salinization and exhaustion of water availability as well as in areas where soil management is inefficiency. The Mediterranean basin is a transition area where desertified areas alternate with areas at risk of desertification.
The EEA and the ETC-LUSI (European Topic Centre Land Use and Spatial Information) consortium have realised a map of European sensitivity desertification index (Figure 8.8).

In Italy, desertification process is becoming always more evident especially in Sardinia, Sicily, Basilicata, Apulia and Calabria.

In Italy, although the situation is not as dramatic as other parts of the world, this process is becoming always more severe in at least five regions (Sardinia, Sicily, Basilicata, Apulia and Calabria) and negative warnings are showing in other areas of Central and Northern regions. Assessing the intensity and extension of desertification is a difficult task due to the absence of a univocal and integrated methodology that can be adopted both at global and regional level.

[9] Source: MATTM, 2006. *Check-list* della Fauna d'Italia, by F. Stoch

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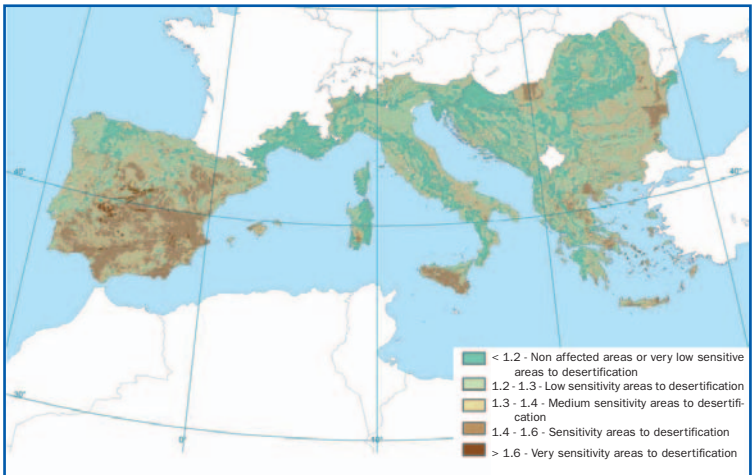

Figure 8.8: European sensitivity to desertification index map (2008)[10]

The Research Unit for Climatology and Meteorology applied to Agriculture (CRA-CMA) has recently published a national map assessing land degradation and desertification processes. In particular, the national map of the ESAI (Environmentally Sensitive Areas Index - Figure 8.9), obtained by applying the MEDALUS method, shows a medium-high degree of environmental vulnerability in Sicily (about 70% of the regional area), followed by Molise (58%), Apulia (57%) and Basilicata (55%). Six regions (Sardinia, Marche, Emilia Romagna, Umbria, Abruzzo and Campania) have a vulnerability percentage between 30% and 50%. Other seven regions (Calabria, Tuscany, Friuli Venezia Giulia, Lazio, Lombardy, Veneto and Piedmont) show a land vulnerability assessment between 10% and 25%, and three regions (Liguria, Aosta Valley and Trentino Alto Adige) show very low values (between 2% and 6%).

[10] Source: Fondazione di Metereologia Applicata, AEA, ETC-LUSI

In Italy, about 33% of the country (equivalent to about 10 million hectares) is vulnerable to land degradation processes, even if at different levels.

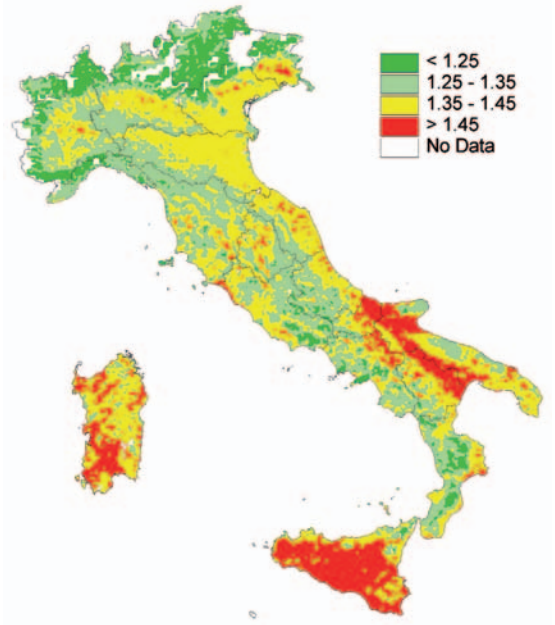

Figure 8.9: National environmental vulnerability index (2000)[11]

The difference between the Italian situation (represented in Figure 8.9) and the one realised on a European scale is due to the utilization of different databases and historical trends that make it difficult to compare results and final vulnerability indexes, even if the same methodology was used.

Extraction activities have temporary impacts and produce permanent changes on land.

Primary and secondary mineral extraction activities (mines and quarries, respectively) represent an important sector of the national economy, which, however, also features a high environmental and landscape impact. Besides the temporary impacts (noise, dust, pollution, etc.), these activities produce deep and irreversible amendments to the landscape as well as a permanent soil loss, possible pollution of underground water and a series of problems related to the use of abandoned areas.

[11] Source: CRA-CMA, CNLSD, MATTM

In the period between 1870 and 2006 a total of 2,991 mines were active. A peak was reached in 1950 which registered 1,247 active mineral sites. Only 194 are now operating.

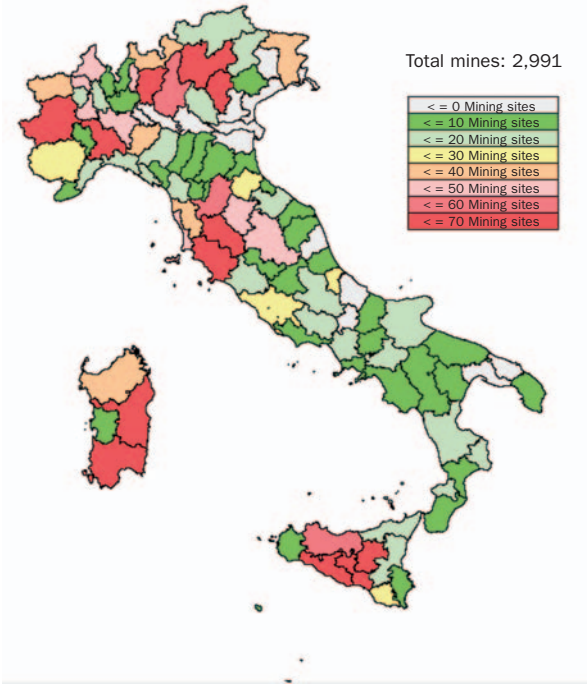

Figure 8.10: Registered mining sites in Italy (2006)[12]

In the period between 1870 and 2006 a total of 2,991 mines were active in 88 provinces out of 103. Mining activities spread nationwide according to a growing trend up to the middle of the last century. Currently, mining is residual and mainly related to the extraction of marlstone for cement, ceramic minerals and minerals for industrial use. The progressive downscaling of mining activities, particularly those related to the extraction of metal ores which produce discards with a high concentration of pollutants, has certainly mitigated the pressure of mines on the environment. However, the serious ecological, health, static and structural problems relating to the hundreds of abandoned mines have not yet been solved.

Mining activities have been scaled down with respect to the last century but problems related to abandoned sites are still unsolved.

[12] Source: ISPRA – Census of abandoned mining sites

Active quarries are distributed throughout the national territory. It is still not possible to make an outline of abandoned or illegal sites.

As regards quarries, data collected from relevant regional offices show that there are currently about 5,400 quarries operating in the country, of which more than 60% extract flood materials and carbonatic rocks. The regions with the highest number of quarries are Veneto, (where the extraction of flood materials is particularly developed), Apulia (with an absolute predominance of limestone extraction), Sicily, Sardinia and Tuscany (which has the highest number of metamorphic rock quarries due to marble extraction sites on the Apuan Alps) as well as the autonomous provinces of Trento and Bolzano. As at today, it is still not possible to make an outline of the thousands of unused or illegal quarries, which can be a source of serious environmental problems related to their intended use.

The regions with the highest number of active quarries are Veneto, Sardinia, Sicily and Apulia. The provinces of Vicenza, Verona, Trento, Bolzano and Bari have more than 140 active quarries in their territories.

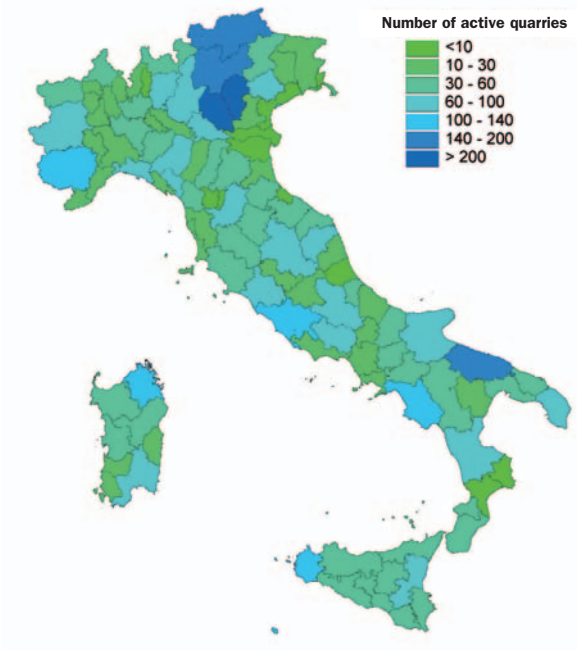

Figure 8.11: Active quarries in Italy (2009)[13]

[13] Source: ISPRA

The most important energy resource deposits are located in: Basilicata (which produces 75% of oil and 12% of natural gas in Italy); Sicily (which produces 10% of oil and 4% of gas); the Adriatic offshore (where there is the highest production of natural gas - 52% in zone A, 14% in zone B and 10% in zone D, respectively in the higher, medium and lower part of the Adriatic coast).
Recoverable reserves are estimated to be about $130*10^6$t of oil and $100*10^6$ Sm^3 of natural gas, but the production is constantly decreasing (Figure 8.12).
Despite the great geothermal potential of the Italian territory only two areas are being exploited, both located in Southern Tuscany (Larderello-Travale/Radicondoli and Monte Amiata). The production of energy from geothermal sources is in any case constantly increasing. The geothermalelectric station installed in Northern Lazio (Latera) was abandoned due to technical and environmental problems.

Most of the country's oil is produced in Basilicata, while natural gas is mainly produced in the higher part of the Adriatic coast. Production of geothermal vapour is developed only in Tuscany.

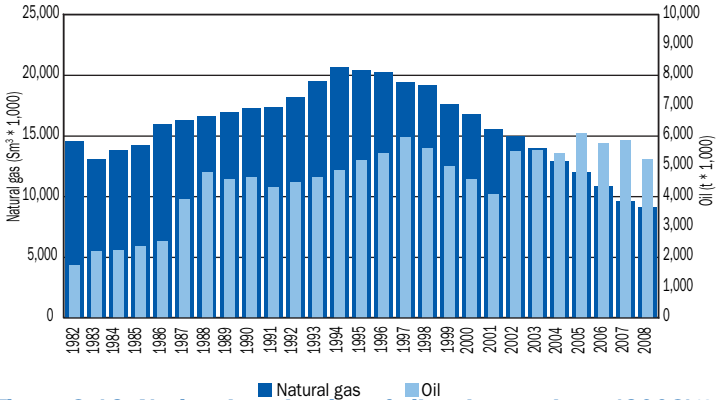

Figure 8.12: National production of oil and natural gas (2008)[14]

Since 1994, the production of natural gas is decreasing due to the decline of old fields that are insufficiently replaced by new findings. Even the production of oil has reduced with respect to 2008 (-11%).

Geosites are geological and geomorphological areas having rare and unique characteristics; they are an important component of our geological heritage and give essential information for our knowledge of the Earth. They also provide an essential contribu-

In Italy are actually counted, about 4,000 geosites.

[14] Source: Ministry for Economic Development data processed by ISPRA

Italy is rich of geosites and geodiversity and therefore of biodiversity (which is produced by geodiversity).

tion to the scientific understanding of the geological history of a region and have an exceptional value for the landscape and for the cultural, educational and recreational life of the land. Geosites are non renewable natural resources that need to be studied and counted as a landscape component that needs to be protected and conserved. Italy, with its particular geological and geomorphological characteristics, is rich of geosites and geodiversity and therefore of biodiversity (which is produced by geodiversity).
Geosites are an expression of the geological, geomorphological, hydrological and pedological variety in a given area. They are important for the life of the different species existing in that area. Conserving the geodiversity and protecting the geological heritage therefore contribute to combating biodiversity loss and maintaining the integrity of ecosystems. Since 2002 ISPRA is updating a database of Italian geosites, which have today reached almost 4,000 (Figure 8.13). Keeping a database of geosites is necessary since this knowledge is at the basis of any protection and sustainable development activity to be carried out in the territory.

The number of geosites differ from region to region according to the progress of census operations.

Figure 8.13: Distribution of geosites in Italy (2009)[15]

The main causes of soil degradation

The various problems related to physical and biological degradation of soil in most anthropized areas (e.g. erosion, compaction, organic substance loss, etc.) are mainly caused by the great transformation suffered by the Italian territory during the last century, when economic development came into contrast with the soil's ecological functions.

The irregular expansion of urban centres, industrial development, springing up of infrastructures, extraction of raw materials and modernization of agriculture (focused on research and maximum productivity) exercised considerable and, at times, inevitable pressure on soil. A large part of the territory was therefore sacrificed

[15] Source: ISPRA

to the society's development needs, often in an inconsiderate way. We have now reached a stage in which we can no longer postpone the protection of this resource and need to adopt policies for the sustainable management of land and soil.

Activities involved with punctual contamination are: oil refining industries, chemical and metallurgical industries, manufacturing of asbestos products and some waste management activities.

The presence of contaminated sites is a problem common to all industrialized countries, as it is often linked to human activities such as industries, mines, waste deposits and other structures that because of spilling, plant/tank leakage, incorrect waste management, etc., may have an impact on local soil contamination. In Italy, the activities mostly involved with punctual contamination phenomena are mainly related to oil refining industries, chemical and metallurgical industries, manufacturing of asbestos products and some waste management activities.

However, diffuse contamination can even be caused by atmospheric fall-out, intensive farming or widespread and/or prolonged human activity. This makes it difficult to identify the exact source of contamination (Figure 8.14).

Diffuse contamination is caused by industrial, civil or agricultural sources. When soil looses its protective functions, polluting substances contaminate water flows and layers entering the food chain.

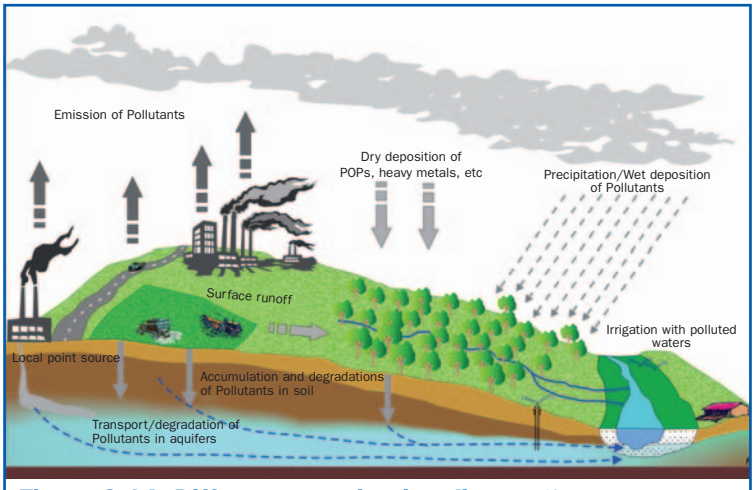

Figure 8.14: Diffuse contamination diagram[16]

[16] Source: ISPRA

Industrial and vehicle emissions that are in the atmosphere cause the release into soils of acidifying contaminants (SO_x, NO_x and NH_3), heavy metals (Pb, Hg, Cd, As, Cr, Cu, Ni, Se and Zn) and organic compounds (straight-chain hydrocarbons, IPA, dioxins, furans, etc.). Intensive farming practices, making abundant use of pesticides, chemical fertilisers and manure, can result in an excess of nutritional elements (N, P and K), in accumulation of heavy metals and in the spread of biocide substances. In particular, an excess of nutritional elements can result in serious groundwater pollution and eutrophization of water ecosystems, since nitrates are highly soluble in water and not easily retained by soil.

Industrial and urban activities release acidifying substances, heavy metals and organic compounds in the atmosphere. Farming practices result in excess of nutritional elements, accumulation of heavy metals and the spread of biocide substances.

The observed trend of excess nitrates has gradually decreased in almost all Italian regions in the last decades, thanks to the measures taken to comply with the current legislation. In some cases, the use of sewage sludge in farming (that can produce significant quantities of hazardous substances if combined with nutrients and organic carbon) has raised concern when it is not correctly managed and controlled.

The nitrate surplus trend is gradually decreasing in almost all Italian regions, mainly as a result of measures taken to comply with the current legislation.

Finally, in specific geological contexts, the high levels of some contaminants can have a natural origin[17]. Infact, an elevated concentration of heavy metals in the soil can be determined by the chemical characteristics of the rock/parent material. Therefore, in order to identify eventual human contamination, action needs to be taken to correctly define the soil's natural content.

Some soils can have naturally high contents of contaminants.

Data collected by APAT/CTN_TES (2005) from a limited number of samples, but covering most Italian regions, highlight an accumulation of Zn, Cu, Pb and Cd in the first 30 cm of soil. This witnesses a human contamination, both industrial/civil (Pb and Cd) and agricultural (Cu and Zn). Other elements (Ni, Cr and As) present higher concentrations below the topsoil, which could confirm a natural content for the areas of reference due to the geological composition of parent material.

When assessing the amount of heavy metals in soil, it is extremely important to distinguish the natural content (background value) from that originated by human activities.

Excessive concentrations or mixtures of pollutants have negative

[17] APAT-ISS: *Protocollo operativo per la determinazione dei valori di fondo di metalli e/metalloidi nei suoli dei siti di interesse nazionale*. June, 2006

Pollution, intensive farming, erosion, compaction, salinization, organic matter decline and sealing are also responsible for soil biodiversity loss and therefore reduce its vital functions.

effects also on soil organisms both directly (emigration or death of the most sensitive individuals or species) and indirectly (development of resistant and generalist organisms). For this reason, soil biodiversity is more and more utilised in soil and contaminated site monitoring programmes. It can be used as a useful biological indicator to integrate chemical and physical data collected during conventional soil analyses.

However, the causes of soil biodiversity loss are not limited only to the presence and persistence of pollutants. Intensive farming also may have a very negative impact. Heavy and frequent farming and the formation of compact layers often reduce the availability of a favourable habitat for soil biota. Reducing the porosity of the so-called "plough sole" also reduces the diffusion of oxygen, water retention and nutrient migration, therefore producing changes in food chains and particularly modifying the type and distribution of soil organisms.

A serious biodiversity loss can also be caused by changes in land use particularly involving soil sealing. Other threats come from decreases in organic matter supply or to its loss due to erosion or following fires. The availability of organic carbon is one of the main factors that determines the growth of soil organisms. Its reduction can inhibit biological activities.

Increase in salt or pH variations in soil are other factors that limit the presence of soil biota and change the structure of microorganism communities.

Finally, the casual or deliberate introduction of allochthonous species often causes invasive demographic explosions that damage autochthonous species, which are in harmony with the environment.

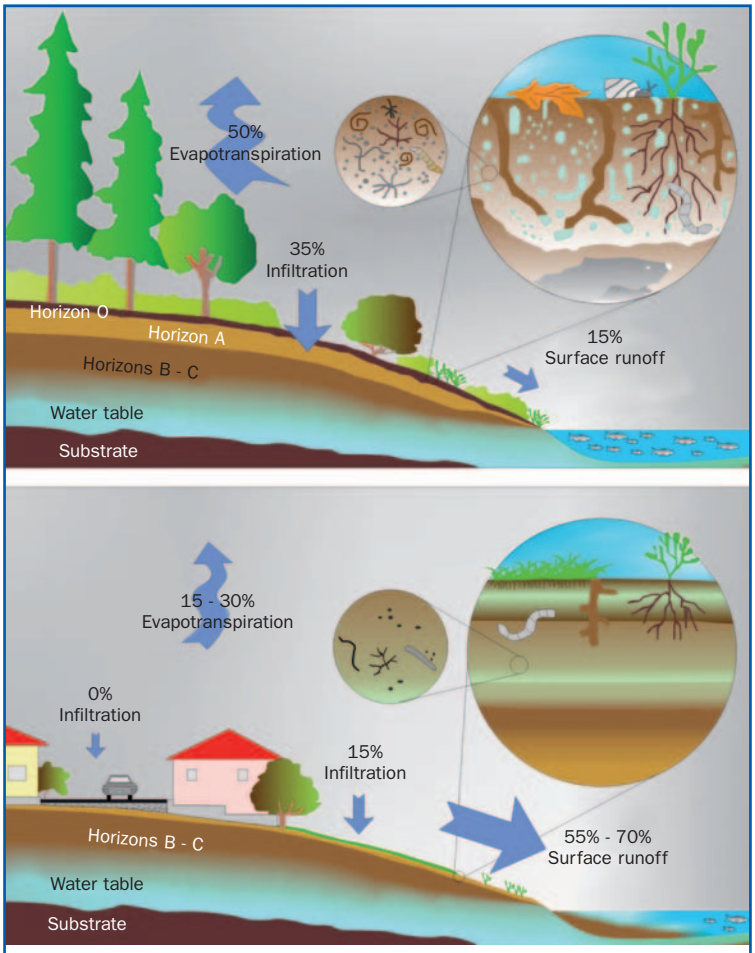

Figure 8.15: Indicative sketch of water movement on natural and anthropised soil[18]

Soil in its natural conditions is able thanks to its porosity, permeability and humidity, to retain a large quantity of water from rainfall contributing to regulate the surface runoff. In an anthropized environment, on the other hand, the presence of impervious surfaces, the reduction of vegetation, the, removal of the surface layer (rich in organic matter) and the onset of compaction processes result in an increase in surface runoff and in the transport of large quantities of sediment in natural collectors.
The values shown in the figure are only indicative and can change significantly depending on a variety of parameters (the physical and chemical characteristics of soil, the topography and geology, as well as the duration and intensity of rainfall, etc.).

Biodiversity loss, which implies a progressive loss of the soil's functional capacities, is also related to the reduction of organic substances.
Organic matter (OM) loss is one of the most serious process of

Organic matter decline is related to transformation of soil's intended use and to intensive farming practices.

[18] Source: USDA-NRCS, 2005. Urban Soil Primer. Redraw by ISPRA

soil degradation. This phenomenon is, on one side, related to land use and land cover changes at different times (impressive deforestation, conversion of forests or of permanent pastures to arable lands, etc.) and on the other side caused by the development of intensive farming practices. Indeed, a great anomaly in agricultural systems adopted during the last century is the breaking of the organic matter cycle, of which agricultural biomass is an important stage. In addition, traditional reintegration practices (especially with manure) were abandoned for a long time. Therefore the input of organic carbon for soils used in these systems mainly relies on a more or less cautious management of crop residues and various other forms of exogenous organic substance supply. Organic matter mineralization processes also depend on the climate and the type of soil. In the Mediterranean, the concentration of OM in soil is generally low. Therefore, in Italy, the speed with which soil problems related to OM reduction arise is clearly higher.

Agricultural practices focused only on productivity have triggered off serious erosion and soil compaction phenomena.

Agricultural practices aimed at supporting specialized and intensive farming have greatly transformed the agricultural landscape and have not been able to keep a balance between production needs and the environment. The abandonment of hydraulic and agricultural facilities and of terracing plots, the levelling of lands, cultivation along steep slopes, excessive crushing of soil clods and the use of always heavier machinery have triggered off dangerous soil erosion phenomena which have caused a loss of surface horizons, rich in organic matter.

Heavy machinery also causes the most serious cases of soil compaction, particularly when used on wet soils. Excessive grazing also has a similar effect while prolonged ploughing at the same depth causes the formation of a compact layer in the soil (plough sole).

The impacts of farming on soil can be mitigated by using innovative farming practices that enable the soil to keep its productive capacity and fertility. The results of a recent project conducted by the European Commission[19] on specific farming systems

[19] Sustainable agriculture and soil conservation – SoCo project - http://soco.jrc.ec.europa.eu/

(conservative and organic farming) have highlighted the important positive effects of applying these alternative farming practices from an economic, social and especially environmental point of view. Farming systems such as no-tillage or reduced tillage adequately combined with cover crop or appropriate crop rotation can reduce soil degradation processes and help to achieve good results (see Table 8.2), such as:

- The reduction of the water erosion risk and subsequent increase in the soil's capacity to absorb water;
- The increase in organic matter and carbon dioxide in topsoil due to the reduced use of pesticides and weed killers, protecting the underlying water table from possible pollution and reducing the storage of greenhouse gases;
- The organic carbon stock, biological activity, above- and below-ground biodiversity and soil structure are all improved. An higher biological activity results in the formation of well-connected, mostly vertical soil macro-biopores that increase water infiltration and resistance to severe packing.

However, the implementation of similar farming systems must inevitably keep into account the initial investments that farmers need to make in specialised machinery, the extensive training and the transition period of five to seven years before a conservation agriculture system reaches equilibrium.

A conservative farming system generally needs between 5 and 7 years before reaching its equilibrium.

Table 8.2: Effects (positive/negative) of farming practices on soil degradation processes and relative environmental issue[20]

Conservation agriculture	Soil degradation processes				Related environmental issue			
	Water erosion	Organic matter decline	Compaction	Salinizatione/ Sodification	Contamination	Biodiversity	Landslides and floods	Greenhouse gas emissions
No- or reduced tillage	2	1	1		2	3		2
Cover crops	1	1	3		1	3		1
Crop rotation	1	1	1		1	1		4
Intercropping	1	1	1		1	1		
Subsoiling			4	4			3	
Contour farming	1							
Buffers	1	3	3		1	1		
Terraces	1	3					2	

Legend:
1 = Positive effect (observed)
2 = Positive/negative effect (observed)
3 = Positive effect (expected)
4 = Positive effect (limited or indirect)

Results of the SoCo (Sustainable Agriculture and Soil Conservation) project highlighted that there are no specific solutions to reduce the effects of soil degradation process caused by the application of inadequate farming practices. Conservative agriculture, which some people still call "Blue Agriculture", can be a solution. But even in this case it is necessary to assess whether it can apply to the soil's specific nature, the type of farm and the production that is planned. Modern agriculture, also aimed at preserving natural resources, cannot avoid having a deeper knowledge of the same resources and studying the "territorialization" of farming management systems.

[20] Source: http://soco.jrc.ec.europa.eu/

The project also highlighted the positive effect of the Common Agriculture Policy reform, which introduced "environmental conditions". The implementation of measures on the "environmental condition", "Mandatory Management Criteria" (MMC) and "Good Agricultural and Environmental Practices" (GAEP) are tools that can have a strong impact on the reduction of soil degradation phenomena.

Italy, like other countries of Mediterranean Europe, is particularly affected by salinization problems related both to factors that cause the formation and natural evolution of soil on particular *parent material* (primary salinization), factors induced by man (secondary) or the concurrence of both effects. In particular, secondary salinization of soils due to irrigation is a problem that is bound to worsen not only because of the strong competition in the use of water between cities, industries and countryside but also due to the overexploitation of water layers, the use of always less adequate water in agriculture (salty waters, civil and industrial refluent water) and the effects of climate change that increases aridity, reduce leaching and therefore increase salinization. Areas that tend to have a hot and arid climate are therefore particularly exposed, such as the coastal areas, where excessive drainage (for agricultural, civil or industrial use) reduces water layers and increases the possibility of saline water intrusion.

Italian coastal areas are particularly exposed to salinization phenomena due to the drainage and use of water, which is becoming always more salty.

The process of soil degradation is therefore related to different factors caused by natural or human pressure. Desertification is the result of this complex system of interaction and takes place when degradation compromises the sustainable productive capacity of agricultural and forest ecosystems in an irreversible way. Climate factors that mostly characterise this process are aridity, drought and rain erosiveness.
The main anthropic causes of desertification are, instead, related to socio-economic activities and their impacts: agriculture, breeding, management of water resources, woodland fires, industry, urbanization, tourism, dumps and extractive activities.

Desertification is the final stage of soil degradation.

All these activities produce a competitive use of natural resources (soil, water and vegetation/biodiversity) and their subsequent overexploitation with respect to their actual availability.

Soil degradation is related to factors caused by natural or human pressure.

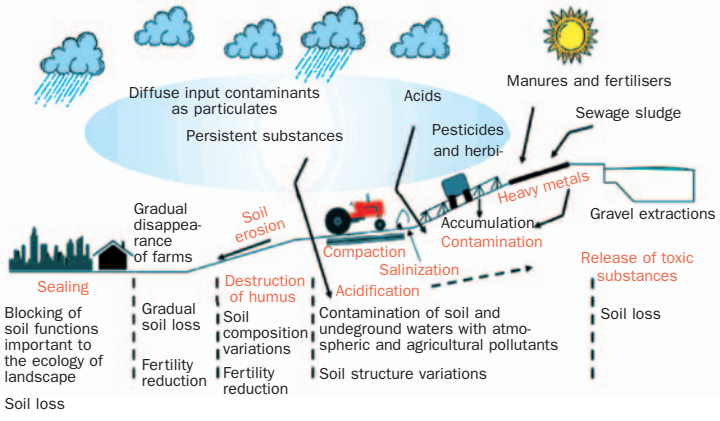

Figure 8.16: Diagram of threats that compromise soil functions. Desertification is the final degradation stage[21]

Action aimed at soil conservation

At European level, the growing awareness of the environmental importance of soil and the need to: contrast its progressive degradation and function loss; limit the development of desertification processes; mitigate hydrogeological instability and reduce human pressure on land has led to a substantial review of the legal framework. The 6th Environment Action Programme, the new Common Agricultural Policy (CAP; Reg. EU 1782/03 and 1783/03) and the directive proposal for soil conservation (COM (2006) 232) acknowledge the environmental function of soil and lay the foundations for the protection and conservation of this resource.

The new Common Agricultural Policy lays the foundations for sustainable agriculture.

Due to problems caused by the application of the old CAP with respect to surplus production, excessive increase in community investments, the emergence of considerable environmental

[21] Source: JRC - IES

damages and progressive reduction of performance, the new agricultural policy is focused on environmental sustainability.
Based on the principles of Agenda 2000, the subsequent medium-term reform of the CAP (Fischler Reform) was a decisive turning point towards an agriculture that could be balanced as much as possible with the environment in order to guarantee productivity even in the future.
The Fischler Reform is based on four main points: *decoupling, modulation, conditionality* and *rural development.*
The principle of "conditionality" is of particular interest to soil conservation. According to this principle, farmers benefit from direct payments only if they observe a series of requirements related to the correct management of land (even in absence of farming). Among these requirements are food safety, respect of the environment, personnel safety, animal health and livelihood.
Farms are therefore supported if they respect the Mandatory Management Criteria (MMC) and they keep the land in Good Agronomic and Environmental Conditions (GAEC). Every year, the Ministry of Food, Agricultural and Forest Policies issues a decree with the full list of MMC and GAEC that need to be respected during the course of the subsequent year, giving single regional authorities time to issue implementation provisions that are more adequate to each specific territory.
In particular, the MMC are legal provisions ("Acts") already in force deriving from the national and regional implementation of the corresponding community laws (e.g. Directive 86/278/EEC "Mud Directive" and Directive 91/676/EEC "Nitrates Directive"). GAEC ("Regulations") are established at national and regional level to guarantee the four priority objectives established by the European Union, namely:

- Protecting soil with adequate measures;
- Maintaining soil's organic substance levels by means of appropriate practices;
- Protecting the soil's structure by means of adequate measures;
- Maintaining minimum ecosystem levels and preserving habitats.

Regulations for keeping land in good agronomic and environmental conditions include: control of surface waters in sloping land;

"Conditionality" obliges European farmers receiving subsidies to guarantee correct soil management. Every year, the Ministry of Food, Agricultural and Forest Policies issues a Ministerial Decree containing the list of regulations that need to be respected.

management of stubble and residue; efficiency of drainage networks for surface water flows; protection of permanent pastures; management of areas withdrawn from production; maintenance of olive groves and protection of the landscape's characteristic elements.

The Strategic National Plan for Rural Development provides addresses for the Regional Rural Development Plans.

The Fischler Reform further strengthens rural development with the introduction of new regulations and the allocation of new resources. The Strategic National Plan for Rural Development prepared by the Ministry of Food, Agricultural and Forest Policies provides addresses for the corresponding Regional Plans and provides four priority objectives for Axis 2 *"Improvement of the Environment and the Rural Area*". These objectives, which intend to strengthen "conditionality" provisions, are:

- Conservation of biodiversity, protection and diffusion of agro-forest systems with a high natural value;
- Qualitative and quantitative protection of surface and deep water resources;
- Reduction of greenhouse gases;
- Land conservation.

The fourth objective must be obtained by means of a series of interventions aimed at mitigating: water erosion phenomena; salinization; compaction; contamination; reduction of organic substance and biodiversity; soil consumption and waterproofing. All regions and autonomous provinces have prepared their own Strategic Regional Plan, making necessary adjustments to the National Plan according to their local needs.

The European Commission prepared a Thematic Strategy that led to the issuance of a "Proposal for a Soil Framework Directive" (COM (2006) 232).

The Common Agricultural Policy reform was influenced by soil conservation addresses contained in the COM EC 179/2002 "Towards a Thematic Strategy on Soil Protection", which underlined the great impact that agriculture has on the environment. In the EU 77% of land is used for agriculture. In particular, in 2000 intensive farming covered 37% of the territory.

In September 2006, the European Commission adopted the Soil Thematic Strategy (COM (2006) 231), the Proposal for a Soil Framework Directive (COM (2006) 232) and the Impact Assessment (SEC (2006)1165) with the aim of protecting European land. These documents confirm the environmental role of soil and identify the threats that can compromise its functions until its final

degradation stage of desertification. They distinguish threats mainly caused by agriculture (erosion, compaction, salinization, organic substance loss and landslides) from local and diffuse contamination and waterproofing. They acknowledge the strong interaction between soils and their environmental matrices and the need to include a strong local component in protection policies due to their extreme variability. The Strategy also requires the verification on the inclusion of soil protection and impact measures in Regional Action Plans. This is necessary to protect soil and comply with the minimum requirements to keep soils in Good Agronomic and Environmental Conditions, as provided by the CAP. Member states must identify "agricultural threats" and areas at risk according to common elements, establish objectives to reduce the risk in the relevant areas and prepare programmes with measures required to achieve these objectives. Programmes can refer to national measures that have already been taken (such as "conditionality"), measures on rural development of the CAP, action plans provided by the Nitrates Directive, etc.
Member states can even freely decide to combine various other strategies to resolve concomitant problems.
Contamination is acknowledged as one of the "priority threats" against the soil's functions. The main elements contained in the strategy are: definition of a common risk-based assessment of "contaminated" and "reclamation" sites; implementation of a systematic procedure for identifying contaminated sites; realization of national registers of contaminated sites and introduction of "reports on soil conditions" as a useful tool during sale transactions of sites hosting potentially polluting activities. The Strategy also highlights the need for member states to define a "National Strategy for Land Reclamation". This should include objectives (number of sites that need to be reclaimed), priorities and an implementation schedule.
This proposal is currently being discussed and reviewed.

At national level, there are many regulations in force to protect soil from pollution. These also involve other institutional departments.
The recovery of contaminated sites can be obtained by means

Legislative Decree 152/06 regulates the reclamation process of contaminated sites and introduces the risk analysis concept.

of more or less complicated reclamation processes. In Italy, these are regulated firstly by Ministerial Decree 471/99, and then by Legislative Decree 152/06 (Part IV, Chapter V) and the relative Corrective Decree 4/08.

Legislative Decree 152/06, "Environmental Regulations" under Part IV, Chapter V "Reclamation of Contaminated Sites" contains new and important elements. Among these is the definition of a potentially contaminated site as: "*a site in which one or more concentration values of polluting substances found in environmental matrices are higher than the Threshold Value of Contamination (TVC), while waiting to carry out characterization operations and site-specific risk analyses that would determine the actual contamination conditions on the basis of Risk Threshold Concentrations (RTCs).* Instead, a "contaminated site" is defined as: *a site in which Risk Threshold Concentration (RTCs) values are exceeded. RTC values are determined by applying the risk analysis procedure as per Annex 1, Part 4 of the said decree based on the characterization plan's results".*

In the decision-making process of identifying and managing contaminated sites, the difference between the Threshold Value of Contamination (TVC) and the Risk Threshold Concentration (RTC) is therefore relevant. If the former is exceeded there is an obligation to carry out characterization and risk analyses. If the latter is exceeded then the site is considered "contaminated" and it is therefore submitted to safety or reclamation operations.

This recent provision introduced clear criteria for the definition of a contaminated site's reclamation objectives, based on a site-specific risk analysis. It therefore updated the definition of "contaminated site" contained in Ministerial Decree 471/99.

Currently, characterization and reclamation projects that were already started and/or approved follow the procedure established by Ministerial Decree 471/99. However, in view of the new decree, the promoter can request to re-examine the documents presented. Projects presented after the issuance of Legislative Decree 152/06 follow the procedure established by the latter.

As regards Sites of National Interest (SNIs), ten years have passed since the issuance of the first regulation. As at today, the percentage of recovered and/or reclaimed areas is still low and

the progress of reclamation activities appears rather scattered over the whole country.
In general, most reclaimed and/or recovered areas are found in the less complicated SNIs. In particular, it is noticed that procedures are faster in areas where highly profitable settlements are planned (e.g. redevelopment of areas for urban or residential use, new production plants, etc.).
Introducing public funding systems and other initiatives aimed at streamlining procedures for the reutilization of polluted areas by the private sector could lead to increased development of reclamation activities and to the productive recovery of contaminated sites for industrial use. This could be done through Legislative Decree 04/08 Art. 252-b) (*Sites of Prominent Public Interest for Industrial Reorganization)* which provides for the involvement of the Ministry of Economic Development.
Programme Agreements are another efficient tool to ensure concerted action between the various actors involved in reclamation activities and in the streamlining of administrative procedures. These have already been signed for SNIs in Brindisi and Eastern Naples.

As regards SNIs the percentage of recovered and/or reclaimed areas is still low.

As mentioned above, Ministerial Decree 471/99 provided that regions should endow themselves with a system of collection and updating of data on polluted sites. This must be done by creating "regional registers of sites to be reclaimed" and adopting the relative reclamation plans. The realization of registers is definitely delayed with respect to the schedule provided by the decree. Those that have been prepared also show very strong differences due to the different criteria used to identify contaminated sites. Indeed, some regions require a preliminary verification for changes in the intended use of sites used for productive activities while others only register the more complex sites.
The establishment of registers was confirmed by Legislative Decree 152/06. The decree introduced substantial amendments on site identification modalities which caused difficulties when comparing information collected in different periods. More generally, when identifying potentially contaminated sites (i.e. areas that host or have hosted potentially polluting activities and which need

Contaminated sites are managed by regions and must be inserted in specific "regional registers of sites to be reclaimed".

to be examined) the criteria for inserting contaminated sites in regional registers often suffer from the lack of a systematic and homogeneous procedure that can be valid for the whole the country.

As regards brownfields, action is being taken in order to revitalize abandoned areas making them an active part of the urban territory. Many areas have already been recovered and generally assigned for residential use, public gardens, shops and public areas while activities for the reorganization of "megasites", especially those located in the Southern regions of Italy, are still very low with respect to the actual potential.

In case of diffuse contamination, the most efficient action is to undertake preventive activities aimed at mitigating the pressure. This can be done by: improving controls of emissions to air and water; limiting the use and distribution of potentially contaminating substances; defining quality criteria for products used in agriculture and limiting the quantities of fertilizers used (according to their composition). The quality of sewage sludge used in agriculture is defined by Directive 86/278/EEC. This was implemented with Legislative Decree 99/92 while Ministerial Decree MiPAF 19/04/99 "*Code of Good Agricultural Practices*" focuses on the correct use of fertilizers in order to avoid a surplus of nutritional elements. Legislative Decree 152/06, Part 3 "*Regulations for protecting soil, combating desertification, protecting waters from pollution and managing water resources*" provides indications on interventions for mitigating water pollution from nitrates and establishes (Annex 7) the regional identification of Nitrate Vulnerable Zones (NVZ) as well as zones vulnerable to plant protection products. The definition of NVZs is a complicated process that derives from the intersection of soil's protective capacities and hydrogeological characteristics with respect to agricultural loads and water quality data (Figures 8.17 and 8.18). These zones were identified at different times throughout the country. Aosta Valley, Trento and Bolzano were excluded since they do not have this problem. An estimate, at basin scale, of contamination of water bodies including local and diffuse contamination phenomena is also provided by Directive 2000/60/EC (Water Directive).

In case of diffuse contamination, the most efficient action is to undertake activities aimed at mitigating the pressure.

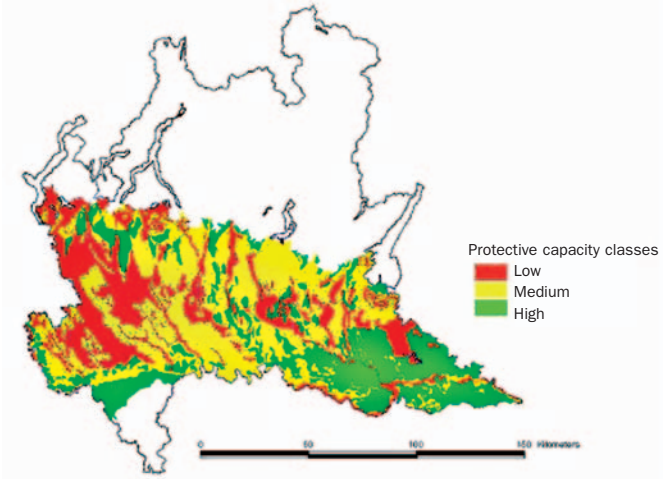

Figure 8.17: Map of soil protection capacity in the Lombard plain with respect to underground waters (2005)[22]

The map shows the potential capacity of soil to retain pesticides within the root zone and for a sufficient amount of time to allow their degradation.

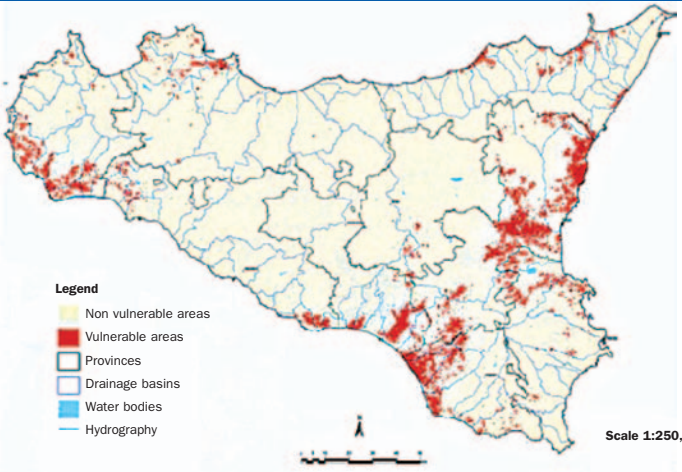

Figure 8.18: Regional map of Nitrate Vulnerable Zones of agricultural origin (2005)[23]

In areas identified as "vulnerable", a series of provisions need to be applied. These regard the management of fertilizers and other agricultural practices as well as measures described in the Code of Good Agricultural Practices.

[22] Source: ERSAF (Ente Regionale per i Servizi all'Agricoltura e alle Foreste – Regional Body for Agricultural and Forest Services) - Lombardy Region
[23] Source: Sicily Region

The United Nations Convention to Combat Drought and/or Desertification is an international legal tool that engages all signatory countries to cooperate in the fight against desertification.

With Law no. 170 dated 4 June 1997, Italy ratified the United Nations Convention to Combat Drought and/or Desertification (UNCCD) signed in Paris in 1994. The Convention is an international legal tool that engages all signatory countries to cooperate in the fight against desertification, with the aim of mitigating the effects of drought in seriously affected countries by means of an approach that improves the conditions of life of the local communities.

The Convention provides for "*the preparation of National Action Programmes aimed at ensuring sustainable development in order to reduce loss of soil productivity caused by climate change and human activities*". To comply with its obligations, with Deliberation CIPE no. 299/99, the Italian Government adopted the National Action Programme (NAP) for the Fight against Drought and Desertification. This highlights that the problem is a matter of concern for the Italian territory particularly with reference to the role played by human activities associated to extreme climatic events, which are always more frequent.

However, since no specific legislative measures aimed at the problem of desertification have been issued so far, Legislative Decree 152/06, Part 3 indirectly refers to this problem as well as the planning and implementation of contrast action in charge of regions and authorities of the Basin. In the last few years, the Ministry for the Environment, Land and Sea has allocated financial resources to the regions that were particularly affected. This is an institutional organism composed of representatives of ministries, public institutions, research bodies and organizations that are institutionally involved in activities aimed at combating desertification.

No specific laws have been issued to fight the problem of desertification. Legislative Decree 152/06, Part 3 indirectly refers to this phenomenon and to the planning and implementation of contrast action in charge of regions and Basin authorities. In the last few years, the Ministry for the Environment, Land and Sea has also allocated financial resources to some of the most affected regions. Even if limited, these resources have started off the definition of local action plans.

With regard to mines, national regulations are based on the

following legal references: Royal Decree no. 1443 of 29/07/1927 (on mine research and cultivation); Decree of the President of the Republic no. 128/59 (on controlling mines and quarries); Law no. 388 of 23/12/2000 (which provides an extraordinary plan for reclamation and environmental recovery also of former mineral extraction areas, on the basis of a subsequent Ministerial Decree); Law no. 179 of 31/07/2002 (which establishes a census of abandoned mineral sites) and Legislative Decree 117/2008 implementing Directive 2006/21/EC (on the management of waste from extractive industries).

Discards from extraction activities (mines and quarries) are regulated by Legislative Decree 117/2008, implementing Directive 2006/21/EC.

Legislative Decree 117/08 establishes measures, procedures and necessary action to prevent or reduce as much as possible, any eventual negative effects on the environment and human health risks caused by the management of waste from extractive industries. The Decree obliges the person in charge of extractive activities to prepare a management plan of extraction waste. This is submitted for approval by the relevant authority. It also provides for the realization of a national inventory of abandoned mineral sites, which needs to be annually updated through the Institute for Environmental Protection and Research (ISPRA).

The decree also considers the management of waste from quarries. This is regulated by regional laws as established by the Decree of the President of the Republic no. 616 of 24/7/1977, which transferred these responsibilities to the regions.

Planning of extractive quarry activities takes place by means of Regional (or Provincial) Plans of extractive activities. These plans contain: a register of active or abandoned quarries, notes on identification and limiting of extraction areas (territorial areas subject to constraints); needs; extraction modalities; excavation times and recovery plans to be followed when planning single interventions (according to the different situations and morphological characteristics).

Planning responsibilities are transferred to regions by means of Regional and/or Provincial Plans of extractive activities.

However, the situation is not harmonized at national level. Regions have different approval times and some regions have still not adopted these plans.

With regard to geosites, following their introduction in landscape planning activities under the "*Cultural Heritage and Landscape Code*" with Law 42/2004, many regions and provinces have

Many regions have started projects for the identification of geosites.

started projects for the identification of geosites in their territory and their introduction in Landscape Plans, which is the first step towards their protection. From a legislative point of view, Emilia Romagna and Liguria are the only regions which have a law for the enhancement and conservation of geodiversity.