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Down to earth: Soil degradation and sustainable development in Europe

A challenge for the 21st century

UNEP

European Environment Agency

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Preface

This third joint message from UNEP and the EEA aims to focus attention on the status of European soils, and to promote discussion on the need for a pan-European (and global) policy on soil, as a basis for the development of legislation and systems for monitoring and managing soil resources. At the same time, there is an urgent need to stimulate and enhance discussion on the role of soil related to the global ecological and economic issues of climate change, industrial development and trade.

In many parts of the world, as well as in Europe, we are now testing the limits of the resilience and multi-functional capacities of soil. Globally, nearly 2 billion hectares of land are affected by human-induced degradation of soils (UN, 2000). The food needs of increasing populations is leading to even greater intensification of agriculture, stretching thereby the capacity of soils to release and absorb nutrients and chemicals. Expansion of built-up areas and infrastructure, particularly in large urban agglomerations, is sealing off the soil from productive uses. Each year an additional 20 million hectares of agricultural land become too degraded for crop production, or are lost to urban sprawl. Soils are being degraded physically and chemically due to erosion, exhaustion (nutrient depletion) and pollution. Soil's diverse living organisms are being reduced, and consequently the cleaning and filtering capacities of soils in many localities are being damaged beyond repair. At the same time, abuse of soil organic matter continues to compromise the potential of soils to sequester and provide interim storage for atmospheric carbon.

In the coming years, sustainable soil use and management will be a great challenge to both users and policy-makers in Europe, as well as globally. The diverse and potentially conflicting demands on the soil resource and its interrelations with climate change, biodiversity and trade will require appropriate action in order not to compromise either its quality or use by future generations.

The planned expansion of the European Union in the early 21st century, the anticipated increase and intensification of agricultural and industrial production in the new member states, and the expansion of built-up areas and infrastructure in Europe will all place considerable pressure on the soil resources of the continent. Present policies and laws and their enforcement mechanisms may prove inadequate for sustainable soil management, unless provision is made for their wise use in perpetuity.

In the end it is a matter of people and the interactions they have on the natural resources and the limited space available. The problem calls for new policies, including fair pricing, fiscal policies, and strategic planning concerning the use of land and natural resources. There is resistance from economic interest groups for such measures as it is seen as limiting liberalisation and reducing speculative expectations. This may become the biggest challenge for sustainability. If we do not get a proper sustainable use of territory and soil, as well as the water and other natural resources that go with them, there is no chance for more sustainable development. Consequently, while some regions of the world and Europe, such as the EU, have a common approach to the environment, it is a matter of concern that the issues of space, soil and land resources are not yet themselves the subject of a common approach.

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Executive summary

Main messages

- Europe's soil resource is being irreversibly lost and degraded at an unprecedented rate as a result of increasing and often conflicting demands coming from nearly all economic sectors, including agriculture, households, industry, transport and tourism. Pressures are generated by the concentration of population and activities in restricted spaces, as well as changes in climate and land use. Since soil is a limited and non-renewable resource, damage to soil is not easily recoverable, unlike air and water.

Contaminated soil poses serious threats to human health

- Major soils problems are: irreversible losses due to increasing of soil sealing and soil erosion, problems of slope stability, continuing local and diffuse contamination, and soil acidification. In some parts of southern and central-eastern Europe, the degradation is so severe that it has led to the reduction of the soil's capability to support human communities and ecosystems, and to desertification. The actual extent of soil degradation is not well known due to data limitations, especially in central and eastern Europe.

- Soil loss and deterioration will continue and will probably accelerate if proper and prompt measures are not taken to de-couple the progress of economic sectors and their pressures on the soil resource through the integration of soil protection measures with sectoral policies.

- Some initiatives with an effect on soil have been undertaken at the local, national and European levels; few are direct, many are indirect and not all are protective. However, a European policy framework on soil protection, similar to those already in place for air and water, does not exist. Moreover, there is no reporting mechanism in place to assess whether existing measures are leading to improvement of soil conditions or to gauge the level of implementation of existing legislation.

- There is an urgent need for an agreed European soil monitoring and assessment framework. Closer collaboration among administrations would be needed for this in order to improve access to information, enhance data comparability and avoid duplication.

Box 1: What is soil?

Soil has a fundamental role in Europe's environment. Thus a broad definition, including all the relevant aspects of land, is adopted here. Soil is a three-dimensional body performing a wide range of socio-economic and ecological functions. It is a complex media formed by a porous matrix, in which air, water and biota occur together with the fluxes of substances and fluids between these elements. Alteration of soil processes leads to changes in the functioning of ecosystems, and many environmental problems which become apparent in other media actually originate within the soil (for further details on soil functions see the chapter on soil degradation in the report EEA, 1999a).

Relevance of the soil resource for Europe

- **Soil is a multi-functional medium**. Soil is not only the basis for 90 % of all human food, livestock feed, fibre and fuel, but also provides services beyond productive functions. Soil forms the spatial dimension for the development of human settlements: the building of houses and infrastructures, recreation facilities and waste disposal. It provides raw materials, including water, minerals and construction materials. It forms an essential part of the landscape, it conserves the remains of our past and is itself a relevant part of our cultural heritage.

- **Soil is not renewable.** Europe's soil has a very high spatial variability: more then 320 major soil types have been identified. Each of these types supports a different range of functions and has a different vulnerability to the various pressures. Soil is, however, a limited resource, and while limited remediation of some functions can be made, soil is not renewable within the timespan needed for its regeneration.[1]

- **Soil's resilience is perhaps soil's worst enemy.** Soil's buffering capacity, its resilience and its capability to filter and absorb contaminants mean that damage is not perceived until it is far advanced. This is perhaps a major reason why soil protection has not been promoted to the same extent as the protection of air and water. It is also an important reason why good monitoring is required. Now, after many years of misuse, the signs and the impacts are showing more clearly and responses are required, both corrective (costly and sometimes not fully feasible) and preventive, so that the problem does not continue to be transferred to future generations.

- **There is competition between concurrent uses of land and soil (food production, living space, infrastructure and industrial production) due to concentration of activities in a small space.** There are also conflicts between private and public use of soil resources. These competing demands, if not properly managed in a sustainable manner, will result in more degradation (unsustainable agricultural practices, soil contamination, sealing, etc), which ultimately will lead, in a vicious circle of decline, to a gradual reduction in the available resource. How these uses can be developed in a sustainable way without damage or depletion of the soil resource is a major challenge for the next decades.

- **There is a clear link between climate change, sustainable development, environmental quality and soil degradation.** Soil is affected by climate change and changes in climate could lead to further soil degradation. At the same time soil plays an important role in the sequestration of atmospheric carbon, through the dynamic process affecting the content of soil organic matter (SOM). SOM is lost through soil degradation (and soil organic carbon with it) and so is the capacity of soil to act as a carbon sink. In developing countries, soil degradation reduces food supplies and contributes to an increase in the number of the so-called "environmental refugees", which may have an indirect effect on Europe. Moreover, protection of soil as the vital resource for agriculture is becoming an issue in negotiations of the World Trade Organization.

- **Soil is a cross-cutting issue.** As soil has multiple users, consideration of soil has to be integrated at different levels. There is a need for administrative (from local to European and global), sectoral (sectors and other environmental issues) and geographical integration (landscapes, urban, rural, mountain and coastal areas) of both soil assessment approaches and soil protection policies. There are appropriate actions to be taken at all administrative levels, from land planning at the local and sub-national levels, to the set-up of environmental and sectoral policies at the national and European levels, and the launch of initiatives on a global scale.

[1] With a very slow rate of soil formation, any soil loss of more than 1 t/ha/y can be considered irreversible within a time span of 50-100 years (EEA, 1999a)

- **"Down to earth, down to basics" - solving soil problems will help solve other problems at the European and global levels**. Soil protection will have multiple benefits. At the European level, as the diversity and multi-functionality of soil contribute to Europe's cultural and natural diversity, protecting soil will help to preserve Europe's resources, its identity and its ability to cope with change. At the global level, combating soil degradation will help offset greenhouse gas emissions, will provide a better environment, will guarantee more food to an increasing population and will contribute to the economic progress of future generations.

Summary of major soil problems

- **Sealing.** The rates of real soil loss due to surface sealing through growth in urbanisation and transport infrastructure are high and similar in several EU countries, such as the Benelux, Germany and Switzerland. These countries are already so intensively urbanised that there is little space available for further expansion. In the Mediterranean countries, urbanisation has been especially rapid in the coastal zones of southern Spain, the Mediterranean islands, southern France and Italy, and this process is linked with the development of tourism. These pressures are likely to remain or increase in the coming years. Soil sealing is also expected to increase within countries with relatively little urbanisation such as Portugal, Finland and Ireland, and in Central and Eastern Europe.

- **Erosion**. Soil erosion by water and wind is a severe and well-recognised problem in southern Europe, as well as in large areas of central and eastern Europe, where impacts are exacerbated by soil contamination due to former industrial operations. Although less severe and thus less perceived, erosion is an increasing problem in the agricultural areas of the European northern loess belt, especially in areas where high-quality and easily erodible soils are subject to more intensive agriculture.

- **Slope stability.** Soil plays an important role in maintaining slope stability. Soil degradation, soil erosion and soil sealing in particular, can be the direct or indirect cause(s) of catastrophic events. Recent disasters underline the impacts of poor land management and poor use of the soil resource. Natural events are occurring more frequently on areas with high relief and steep slopes, intense precipitation and harsh climate, such as the Alpine and the Mediterranean regions. However, damage to soil due to flooding is also occurring in lowlands.

- **Contamination**. Except for acidification, there is no widespread diffuse pollution of Europe's soil. However, contamination is high in restricted areas or hot spots (urban areas and industrial compounds), due to both diffuse and localised sources. Although there has been a reduction in emissions and use of some hazardous substances, mainly due to application of policy measures, these are countered by a general increase in economic activity. Based on available data, losses deriving from industrial activities and former waste sites are the major causes of local contamination in most of the countries analysed. The intensity of agricultural chemical use is highest in the lowlands of western Europe: Denmark, the Netherlands, Belgium, Luxembourg and the north of France. In Europe's eastern region, problems of diffuse soil contamination are greatest in Azerbaijan, Belarus, Moldova, Russia and Ukraine.

'Le crete toscane' (Tuscany's clay soils) (Val d'Orcia – Tuscany)

- **Acidification** through deposition from the air is a continuing problem, but it is not expected to increase further in Western Europe due to the success of policies developed over the past 30 years. However, soils under severely acidified conditions are difficult if not impossible to rehabilitate. In central and eastern European countries, the problem may still worsen before improving. Acidification is occurring mainly in north-western and central Europe.

- **Soil degradation in central and eastern Europe.** The economic crisis which followed the collapse of the former Soviet Union has resulted in general in lower pressures on the environment and on soil in particular. As the economies recover, if proper measures are not taken an increase of soil impacts can be expected following similar trends to those that have been observed in the EU over past decades. However, the effects of past mismanagement of soil in these countries have not been eliminated and this still limits the use of soil today in some areas. In the new independent states (NIS), for example, severe soil degradation is currently observed in specific areas, due to contamination by heavy metals, persistent organic pollutants and dioxins around industrial sites and urban areas as well as salinisation, oil spills and contamination by radionuclides.

- **Data gaps**. On the basis of the few data available, only a general assessment of the conditions of soil in Europe is possible to date. In fact there are important gaps, and access to relevant data and information is difficult. Since soil has many users, data on soil have been gathered by different organisations for different purposes. Few data can be directly used for policy purposes and most cover small geographical areas. These gaps in the available information limit the ability to produce a more complete assessment.

Box 2: Environmental "hot spots" in former-Yugoslavia

In May 1999, soon after the end of the Kosovo Conflict, a joint UNEP/UNCHS (Habitat) Balkans Task Force (BTF) was established with the objective to assess the consequences of the conflict on the environment and human settlements. The Task Force concentrated, among other issues, on the environmental consequences of air strikes on industrial sites, the environmental consequences of the conflict on the Danube river and the possible use of depleted uranium weapons in Kosovo. (UNEP-UNCHS, 1999). BTF found environmental 'hot spots' in four areas (Pancevo, Kragujevac, Novi Sad and Bor) which required immediate action and further monitoring. At all of these sites, environmental contamination due to the consequences of the conflict was identified. However, part of the contamination identified at some sites pre-dates the conflict. During the investigations it was occasionally difficult to separate problems caused from past contamination from those caused by the conflict itself. Recommendations for immediate action included, among other work, cleaning of water courses, decontamination of soils from mercury, dioxins and PCBs in some areas. For further information on BTF follow-up activities consult the UNEP Balkans-task force website (http://balkans.unep.ch).

Soil is an essential part of the landscape and helps preserve our cultural heritage (Hilly landscape near Pienza, Val d'Orcia – Tuscany)

Why is soil important for Europe?

How soil protection can contribute to sustainable development

Soil's multiple functions, users and threats

Preservation of the soil resource is an important issue not only at the national level, but also at the European and global levels. Soil is not only the basis for 90% of all human food, livestock feed, fibre and fuel, but also provides more than productive functions. Europe's soil forms the spatial dimension for the development of human settlements: the building of houses and infrastructures, recreation facilities and waste disposal. It forms an essential part of the landscape, conserves the remains of our past and is itself a relevant part of our cultural heritage. However, soil is a limited and not renewable resource, and unlike air and water, damage to soil is not easily recoverable.

On this soil multi-functionality is based the soil paradox: its relevance to a wide range of human activities makes it more vulnerable to damage and depletion from many sides. Its buffering capacity, its resilience and its capability to filter and absorb contaminants mean that damage is not often perceived until it is far advanced. Now, after many years of misuse, warning signs are appearing more clearly both locally (e.g. soil contamination in cities) and regionally (e.g. loss of agricultural productivity). If further irreversible damage is to be prevented, responses are required, both corrective (costly and sometimes not fully feasible) and preventive, so that problems are not simply transferred to future generations.

Desertification is an extreme example of how ongoing soil degradation – due to the interaction of various factors such as climate and unsustainable use of water and land resources – can lead, under certain circumstances, to the gradual and progressive reduction in the capacity of the soil to support human and animal communities, vegetation and economic activities and how soil degradation can have social and political impacts. A correct response to the problem would therefore involve different levels of actions, at the local, national and global levels, as well as actions to integrate environmental policies into sectoral policies.

Desertification is not only a problem of regions of the world subjected to an arid climate (drylands), but currently threatens parts of southern and central-eastern Europe. Extensive areas in the Mediterranean region have become so severely degraded that they are no longer capable of supporting any profitable cultivation, resulting in land abandonment and depopulation (EEA, 1998). Moreover, very serious problems occur in neighbouring regions, especially in northern Africa and central Asia.

Soil and sustainability

An important consequence of soil multi-functionality and the limited availability of the resource – and one of the main causes of soil degradation – is an increasing competition between concurrent uses of soil and land (feed people, increase space for living and industrial production, enhance sources of energies, improve mobility). The question is how these uses can be developed in a sustainable way without damage and depletion of the soil resource (Blum, 1998).

In fact, the current increase in the pressures on soil resources at the European and global levels is linked to the increasing demand for soil and land resources to satisfy diverse needs.

At the global level, the need to guarantee food security to a growing population will require more agricultural land or, more probably, an intensification of agriculture in currently cultivated land. On the other hand, overall population increase, industrial activities, changes in urban patterns and behaviour (sub-urbanisation and urban sprawling), together with the need for increased mobility, will also require more land for irreversible uses. These competing demands, if not properly managed in a sustainable manner, will cause more degradation (unsustainable agricultural practices, soil contamination, sealing, etc), which will ultimately lead to even fewer resources being available, resulting in a vicious circle of decline.

At the European level, the already limited space available for the development of human activities will require in the future more attention from policy makers when framing either sectoral, environmental or spatial planning policies. Certain regions are already saturated, such as most of the coastal areas around the Mediterranean, where there is already high competition for the same patch of land, with important consequences to the soil resource and the environment as a whole (see sections on "What is happening" and "Hot spots").

The role of soil as a cross-cutting issue needs to be recognised, as a wide variety of economic sectors use the soil resource and play a part in contributing to soil degradation at different levels. The consequent reduction of soil functionality has an effect on the environment as a whole (Fig. 1).

Promoting soil protection will have multiple benefits. At the European level, the diversity and multi-functionality of soil contribute to Europe's cultural and natural diversity. Hence, protecting soil will help to preserve Europe's identity and its ability to cope with change.

At the global level, combating soil degradation will help offset greenhouse gas emissions, provide a better environment, guarantee more food to an increasing population and contribute to the economic progress of future generations (see Box 4 on soil and climate change).

Soil, agricultural policy and the world trade

Negotiations within the World Trade Organization (WTO)are also contributing to the increasing relevance of soil protection on the European political agenda. Current debate shows that very different and contrasting views on the importance of soil for agricultural production exist between the European Union and other groups of countries. For example, the Unites States and the Cairns Group (Australia, Argentina, Brazil, Canada and others) look at soil mainly as a substrate for agricultural production, more or less neglecting the environmental importance of soil for the protection of groundwater, biodiversity and other environmental targets. In contrast, the EU and Japan among other countries strongly aim at a multi-functional use of soil, regarding agriculture as one of several important uses.

These contrasting viewpoints are very understandable given the different spatial distributions of agricultural soils in relation to urban, industrial and transport systems in which agricultural soils simultaneously fulfil different important functions. All these different functions of soils are of concurrent importance in Europe, due to the concentration of activities in a small space and the high competition arising from ecological and socio-economical uses of soil resources. This is not the case in the United States, Canada, Australia and other members of the Cairns Group, because the amount and distribution of agricultural land with regard to other land uses, e.g. urban settlements, industrial premises and transport routes, is spatially very different from Europe[2]. Nevertheless, urban sprawl in relation to consumption of agricultural soils around cities, is now a well-recognised problem in the United States.

It is therefore important for Europe to be able to substantiate and support its standpoints with reliable information, in particular on the impacts of various sectors on the soil environment, as well as soil conditions. To this end, it is worth mentioning the OECD initiative for the development of soil quality indicators in the context of sustainable agriculture.

[2] For example, the area of agricultural land in the United States is three-fold as compared to the EU, while population and GDP are approximately the same.

What's happening to Europe's soils?

Major issues

The geographical dimension of soil degradation

Europe's soil resource is being lost and degraded as a result of increasing and often conflicting demands coming from nearly all economic sectors, such as agriculture, households, industry, transport and tourism. Pressures are coming from concentration of population and activities in restricted spaces, as well as changes in climate and land use.

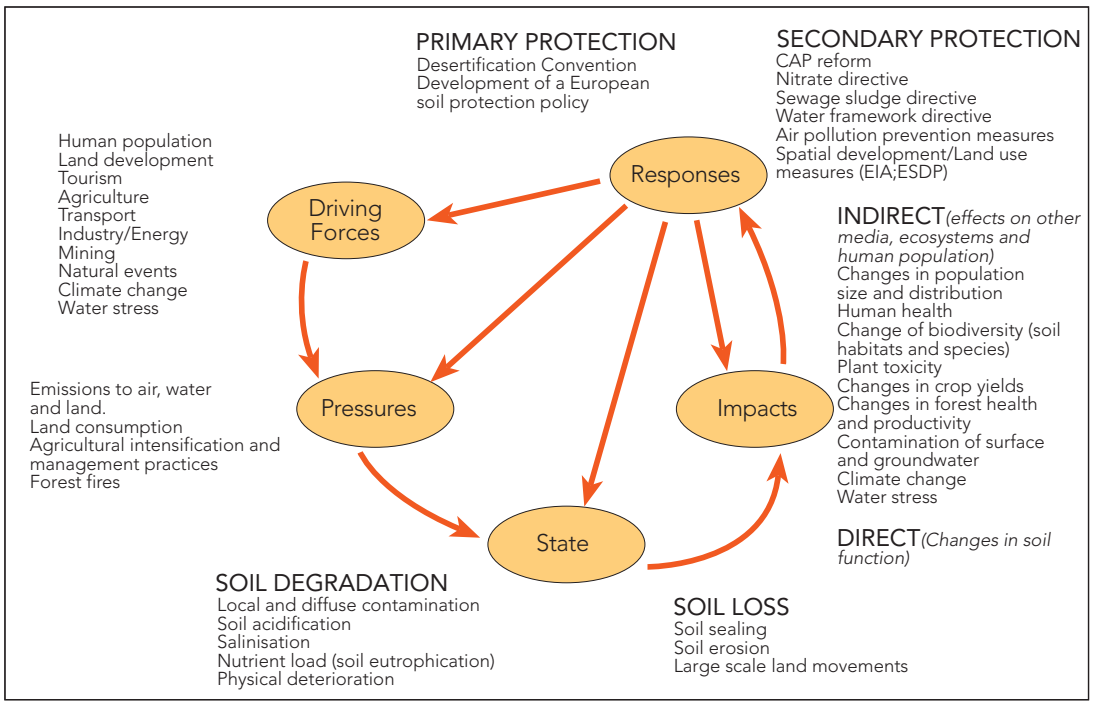
The geographical distribution of soil degradation depends on several factors. Soil problems are influenced by the diversity, distribution and specific vulnerability of soils across Europe. They also depend on geology, relief and climate. A further factor is the distribution of driving forces across the continent and within each region or climatic zone.

In southern Europe, especially in the Mediterranean basin, soil erosion by water and wind, salinisation and the degradation of soil fauna and flora through forest fires plays an important role, while in western, central and eastern Europe, soil contamination and pollution due to urbanisation and industrialisation occur over large areas.

Competition between different uses of soil, leading to soil contamination and consumption of the soil resource, is becoming more severe in the Mediterranean region, mainly as the result of increasing urbanisation and tourism. In fact, the Mediterranean is the most popular tourist region in the world, accounting for 30% of international tourist arrivals, while one-third of its population is concentrated in coastal areas (EEA, 1999a,b).

In Scandinavia, soil health and functions are highly endangered by acidifying air pollution stemming from industrial and other processes in western, central and eastern Europe, transported by prevailing winds to the north and deposited there. In addition, the forest cover of Scandinavia

Figure 1 **DPSIR framework applied to soil**



Source: European Environment Agency

filters inorganic and organic pollutants out of the atmosphere, thus accelerating the degradation of soils, which have a very low natural buffer capacity against acidification and low storage capacities for most pollutants.

Major soil problems in Europe are summarized below and include: loss of the resource due to erosion, sealing, flooding and large mass movements; local and diffuse soil contamination, especially in industrial and urban areas; soil acidification. The report does not cover soil contamination by radio-nuclides.

The DPSIR framework applied to soil and the Multi Function-Multi Impact approach have been used to carry out the assessment (Fig. 1; EEA, 1999a).

The geographical distribution of soil problems in Europe is further discussed in next section, while specific aspects of soil degradation in central and eastern Europe are described in Box 5.

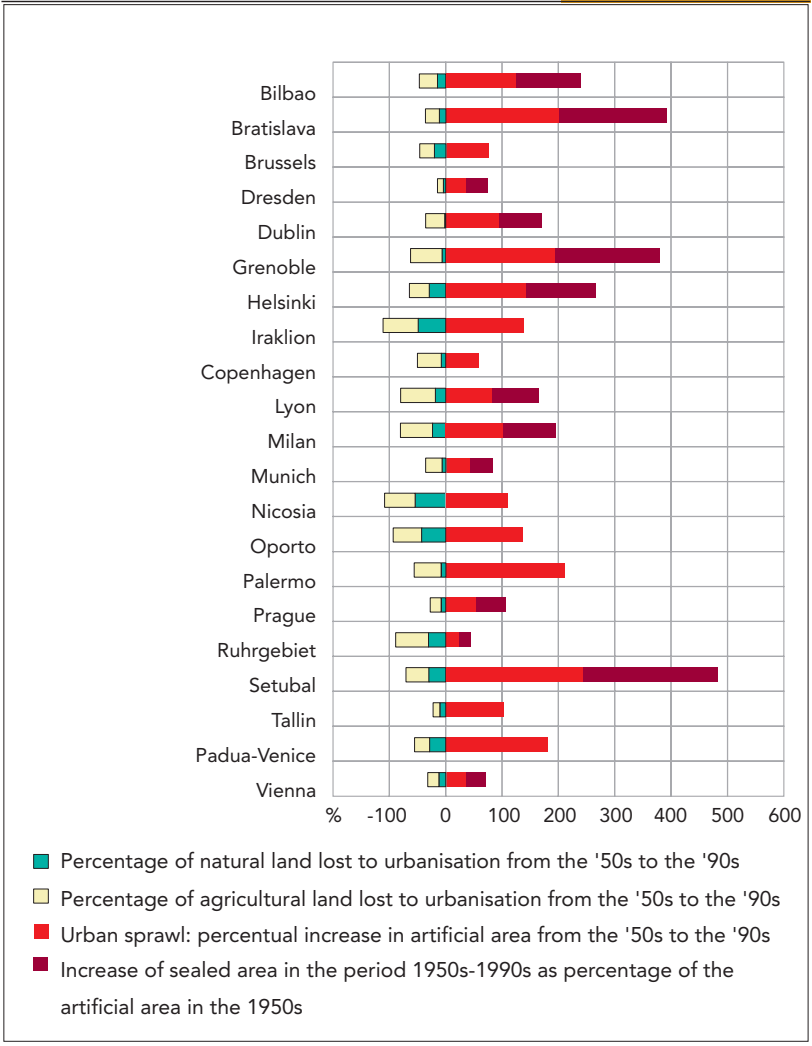
The coverage of information of this pan-European assessment is incomplete. The improvement of this will be one of the major objectives of further work.

Consumption of the soil resource due to urbanisation

The rates of soil loss due to surface sealing through growth in urbanisation and transport infrastructure (roads, airports, railways, ports, etc.) are high and similar in several EU countries, such as the Benelux, Germany and Switzerland. In Germany for example, the average daily loss was more than 120 ha in 1997 (EEA, 1999a).

Soil sealing is becoming a problem in the Mediterranean region, mainly due to the development of tourism. In 1985 almost 90% of urbanised land was located along the coasts of Spain, France, Italy, Greece and former-Yugoslavia. This rate is likely to increase in the next fifty years, according to the Blue Plan (EEA, 1999b).

Loss of natural and agricultural areas due to urbanization in selected European cities from mid-1950s to late 1990s — Figure 2



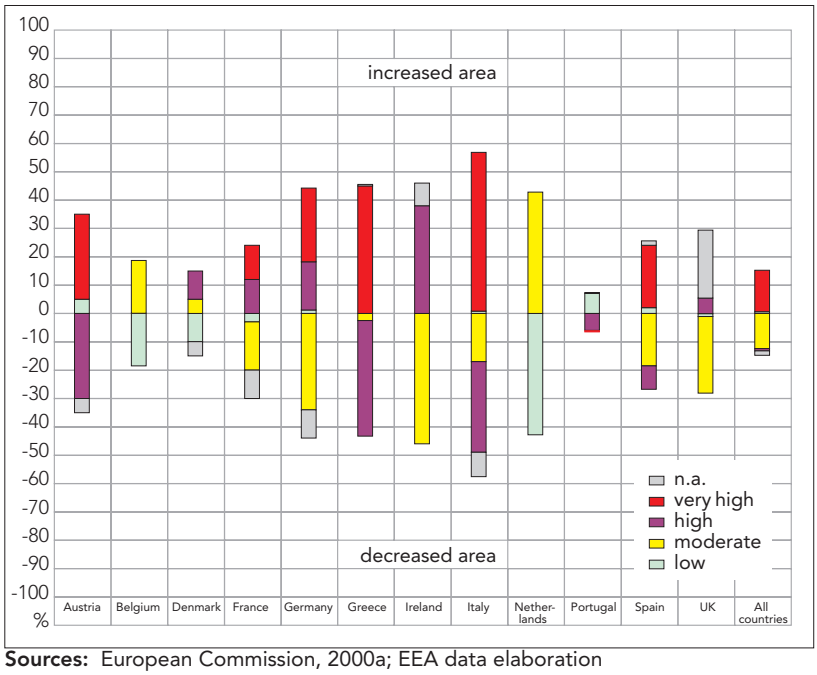
Source: European Commission-Joint Research Centre - EEA data elaboration, 2000

Notes: Data shown here are the results of the European Commission's Murbandy project (Monitoring Urban Dynamics), which has the aim to study current and past land uses in cities, monitor urban dynamics, develop urban and environmental indicators and elaborate scenarios for urban growth.

An example is provided in order to help interpret the diagramme. In the case of Helsinki, in the period 1950-1998, natural land lost to urbanisation was about 30% of the area occupied by natural land in 1950. The loss of agricultural land was about 35% of the total agricultural land in 1950. In the same period, artificial surfaces increased more than 140% of the 1950 artificial area; most of the increase (nearly 130% of the 1950 artificial area) was sealed (waterproof) areas.

In most of the central and east European countries, loss of soil due to urbanisation and industrial development has been modest in the past decades. However, some areas of the new independent states are so heavily transformed by mining and heavy

Figure 3 **Projected changes in water erosion risk in agricultural areas in the period 1990-2050 as % of total land area.**



Sources: European Commission, 2000a; EEA data elaboration

industry, as to give rise to the term "industrial desertification". In Ukraine, for example, this phenomenon extends to 3% of total land area (National Report on the State of Environment in Ukraine, 1997).

Soil sealing is particularly evident in urban areas across Europe (see Fig. 2). In the last 50 years artificial areas have more than doubled in Setubal (240%), Palermo (210%) and Bratislava (200%). In the Ruhr region, where the artificial surface accounts for more than 78% of land area, the increase has been modest. In the same period, total losses of agricultural and natural areas due to increase in artificial areas have been consistent in some cities, with peaks of 41% in Iraklion and 37% in Milan and Nicosia.

Location of problem areas for soil sealing is shown in the next section.

Brownfield redevelopment, i.e. the re-use of abandoned industrial areas for new urban development, has been identified as a response to the increasing demand for land resources. Some EU countries – Belgium, Germany, Italy, the Netherlands and UK among them – have initiated such redevelopment projects and some have defined targets. However, soils of former industrial sites can be heavily polluted and their remediation could be economically or technically infeasible (see section on contamination).

Loss of soil due to erosion

Soil erosion by water and wind is a major problem, especially in southern Europe. It is caused by a combination of harsh climate, steep slopes, thin vegetation cover and poor agricultural practices. The areas with the greatest severity of soil loss due to both wind and water erosion are the Mediterranean, the Balkan Peninsula and the countries surrounding the Black Sea. In Ukraine, for example, 41% (17 million ha) of agricultural land was subjected to water and wind erosion in 1996 (National report on the state of Environment in Ukraine 1997). In Russia, 57% of agricultural land, of which 65% of arable land, is subject to strong erosion (SCRFEP, 1998). Erosion due to water is also becoming increasingly relevant in the northern loess belt.

Location of problem areas for soil erosion is shown in the next section.

Under the EC baseline scenario[3], the water erosion risk is expected to increase by the year 2050 in about 80% of EU agricultural areas, as an effect of climate change. The increase will mainly take place in the areas where soil erosion is currently severe (EEA, 1999a). The direction of change in individual countries is shown in Fig 3.

Soil erosion leads to both on-site impacts (e.g. loss of soil organic matter and loss of soil functions) and off-sites impacts (e.g. contamination and loss of soil's capacity to sequester atmospheric carbon). For example, in many areas of Europe, where soils have been cultivated for long periods and have been subjected to severe degradation processes, the content of organic matter is currently low or very low. In southern Europe, in particular, it has been estimated that nearly 75% of total land area analysed, corresponding to more than 100 million hectares, has a low to very low content of organic carbon in the topsoil (European Commission, 2000b). Possible impacts of loss of organic matter on climate change (in terms of changes in soil organic carbon) are described in Box 4.

Changes in slope stability

Soil plays an important role supporting slope stability. Soil degradation, soil erosion

[3] The baseline scenario is for the present EU and takes into account both policies in place and in the pipeline by August 1997. The assumptions are taken from the European Commission's pre-Kyoto business-as-usual scenario.

and soil sealing in particular, can be the direct or indirect cause of catastrophic events. Floods and mass movements of soil can cause erosion, pollution and loss of soil resources, in a complex inter-linkage of causes and effects. Major impacts can occur to populations, human activities and soil resources through loss of human lives, displacement of population, damage to buildings and infrastructures, and loss of agricultural land.

Natural events are occurring more frequently on areas with a high relief and steep slopes, intense precipitation and harsh climate, such as the Alpine and the Mediterranean regions. In Italy, for example, more than 50% of the territory has been classified as having a high or very high hydro-geological risk, affecting 60% of the population or 34 million inhabitants. More than 15% of the territory and 26% of the population are subjected to a very high risk (Italian Ministry for Environment, 1999). The impacts on population and the economic damage are relevant. In the last 20 years floods and landslides had an impact on more than 70 000 people and caused economic damage of nearly 11000 million EUR (see Fig. 4). Real impacts are underestimated, since data is only available for a small number of events.

Damage to soil due to flooding is also occurring in lowlands. In the UK, for example, there has been an increase of flooding events in the last three years (EA, 2000d). The latest flooding (autumn 2000) is considered the worst in living memory: in the North-East of England the area of land flooded was bigger than Lake Windermere, England's largest natural water body (EA, 2000b). Real costs still have to be calculated (see Box 3).

Contamination of soil due to the spread of chemicals

Except for acidification, there is no widespread diffuse pollution[4] of Europe's soil; however, contamination is high in restricted areas (hot spots), usually urban areas and areas around industrial facilities (Bak et al.1997, Gzyl, 1999, Horvath, 1996; Eriksson et al., 1997).

Local contamination (contaminated sites) is an emerging issue and usually affects areas with a high density of urban agglomeration and with a long tradition of heavy industry, or occurs in the vicinity of former military installations. The seriousness of the problem is linked to its consequences on human health and ecosystems, and its irreversibility. The major impact is often a limited access to resources such as clean drinking water.

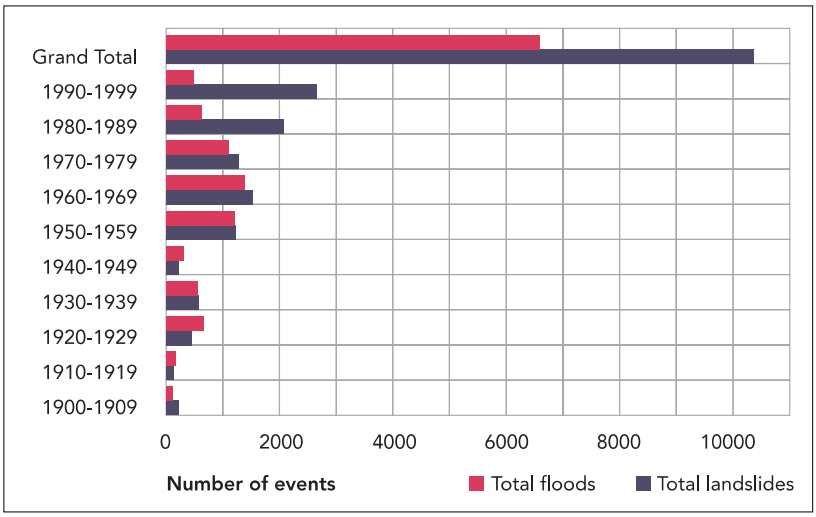
It is usually extremely difficult, and practically or economically impossible, to restore a full multi-functionality of degraded or polluted

Box: 3 Economic losses of flooding in the UK

Millions of homes in the UK are reported to be affected by some sort of environmental risk, of which about two millions are under risk of floods (Sunday Times, 2000a). For the latter, property value under threat has been estimated to be more than 350 billion EUR. Another 3.8 million of new households foreseen over the next 20 years could considerably add to the problem*. (EA; 2000a,c)
Over the last few years, total losses from flooding in England and Wales cost more than 1000 million EUR per year. In 1999 insurance companies paid about 85 million EUR in domestic flood claims and 30 million EUR in the first three months of 2000 only. (EA; 2000c).
The damage related to the cost of flooding in Autumn 2000 in the UK has yet to be fully evaluated.

* The projected increase of households refers to the period 1991-2021 in England (DETR, 1999).

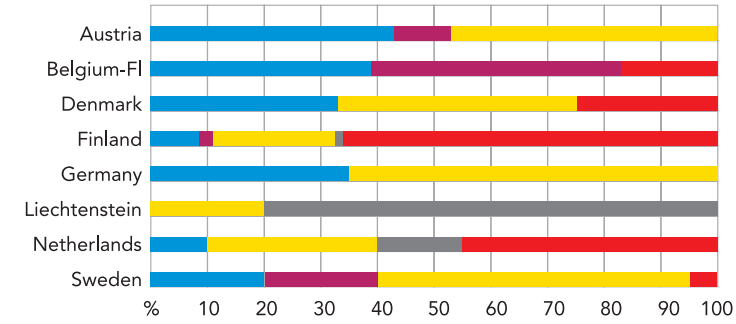
Landslide and flooding events in Italy in the last 100 years Figure 4



Sources: EEA data elaboration from AVI database update 30-6-99 Italian Council of Ministers-Department of Civil Protection & National Research Council-Gruppo Nazionale per la Difesa contro le Catastrofi Idrogeologiche. (CNR-GNDCI) (http://avi.gndci.pg.cnr.it/)

[4] Diffuse contamination and local contamination are often treated as distinct soil problems. Diffuse contamination is generally caused by contaminants transported over wide areas, often far from the source. It includes heavy metals, acidification, nutrient surplus (eutrophication), etc. Local contamination (contaminated sites) is a problem in restricted areas (or sites) around the source, where there is a direct link to the source of contamination. This distinction has an historical origin and it is mainly made in relation to the different management, legal and liability aspects involved. Both types of degradation may be present within the same problem area or hot-spot, such as in highly-contaminated areas around cities where soil pollution is caused by localized sources (e.g. landfills) as well as diffuse sources (road transport). In agricultural areas, instead, diffuse contamination due to the overuse of fertilisers could be the main problem.

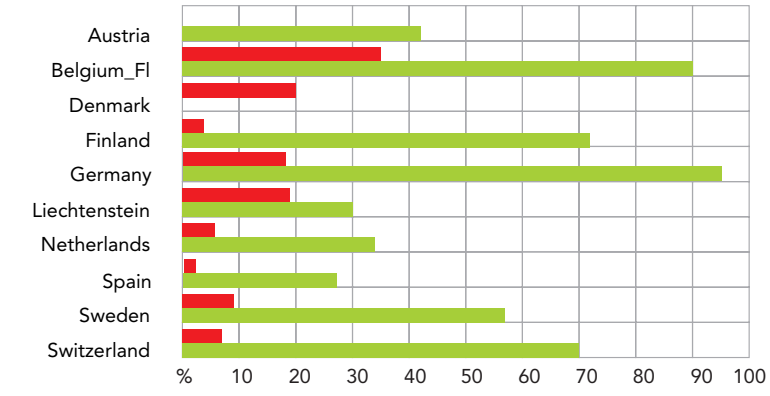
Figure 5 **Major causes of local contamination in selected European countries**



	Austria	Belgium -Fl	Denmark	Finland	Germany	Liechten-stein	Nether-lands	Sweden
Municipal Waste Disposal	43	39	33	9	35		10	20
Industrial Waste Disposal	10	44		2				20
Losses during industrial activities	47		42	22	65	20	30	55
Pipelines								
Accidents				1		80	15	
Others		17	25	66			45	5

Source: EEA

Figure 6 **Progress in the management of contaminated sites in selected European countries**



	Austria	Belgium _Fl	Denmark	Germany	Finland	Liechten-stein	Nether-land	Spain	Sweden	Switzer-land
Detailed phase	0%	35%	20%	18%	3%	19%	6%	2%	9%	7%
Screening phase	42%	90%	0%	95%	72%	30%	34%	27%	57%	70%

Source: EEA

Note: Identification of contaminated sites is composed of two phases: a screening phase, where sites with a high potential to be contaminated are identified, and a detailed phase, where a detailed investigation and assessment of potentially contaminated sites is carried out, in order to decide whether clean-up measures need to be implemented. Country estimations are given as percentage of sites treated in each phase against a baseline number (total number of sites of interest).

soil. In some countries remediation strategies aim to restore soil to perform only some of its functions.

Atmospheric depositions, overuse of agro-chemicals, losses during industrial processes and improper waste disposal are the major causes of soil contamination. Major pollutants include heavy metals, organic contaminants (PAHs, chlorinated hydrocarbons, PCBs and dioxins pesticides) and artificial radio-nuclides. Fig. 5 illustrates major causes of local contamination in selected western European countries. Losses deriving from industrial activities are the major cause of local contamination in most of the countries analysed.

Contamination of soils and groundwater around military sites poses problems especially in the Baltic States, Czech Republic and Hungary. For example, in Estonia abandoned military bases cover about 1.8% of the country's territory; contaminants such as oil products and specific components of rocket fuel were still reported in soils and ground waters in 1996 (Estonian Ministry of the Environment, 1997).

Progress in the identification of contaminated sites in some western European countries is summarised in Fig. 6. It is not possible at present to make a more comprehensive assessment of progress in the management of contaminated land in the EU, because the available information is far from complete.

Soil acidification occurs as a result of emissions of acidifying pollutants from transport, industry and natural bio-geochemical cycles, re-depositing onto the soil surface mainly via dry depositions and rainfall. Exceedances of critical loads for acidification and eutrophication on terrestrial ecosystems are at present mostly dominated by nitrogen deposition. The situation is not homogeneous across Europe, and some hot spots have been identified. In particular, critical loads are exceeded in much of northern and central Europe.

Soil acidification is not expected to increase further in western Europe, due to the success of policies developed over the past 30 years; but in CEE countries the problem may worsen before improving (EEA, 1999b).

Nevertheless, soils under severe acidified conditions are difficult if not impossible to recover if pollution does not stop. For example, in the Russia Federation, it is

Box 4: Soil and climate change

The interrelations between climate change and changes in soil quality are complex and not fully understood. Assessments of the impacts of climate change on soil properties and performance, as well as the influence of soil on global change, are mostly based on hypothetical scenarios and data obtained under controlled conditions. Thus, predictions are rather more qualitative than quantitative and could contain significant bias.

Nations Framework Convention on Climate Change (UNFCCC).

It has been estimated that terrestrial carbon sinks represent an average net sequestration of 2.3 Gt of carbon per year (the same amount of carbon is sequestrated by ocean sinks), against 6.3 Gt emitted from fossil fuels and industrial activity, 1.6 Gt emitted from land-use changes (mainly deforestation) and 3.3 Gt of carbon which accumulates in the atmosphere every year (IGBP, 1998) (IPCC,

Table 1: Global carbon stocks in vegetation and soil carbon pools down to a depth of 1 m

Biome	Area (10^9 ha)	Global Carbon Stocks (Gt C) Vegetation	Soil	Total
Tropical forests	1.76	212	216	428
Temperate forests	1.04	59	100	159
Boreal forests	1.37	88	471	559
Tropical savannas	2.25	66	264	330
Temperate grasslands	1.25	9	295	304
Deserts and semideserts	4.55	8	191	199
Tundra	0.95	6	121	127
Wetlands	0.35	15	225	240
Croplands	1.60	3	128	131
Total	15.12	466	2 011	2 477

Notes: There is considerable uncertainty in the numbers given, because of ambiguity of definitions of biomes, but the table still provides an overview of the magnitude of carbon stocks in terrestrial systems.

Biomes are the major regional communities of plants and animals that can be discerned at a global scale. They have similar life forms and environmental conditions. They are named after the dominant type of life form. There are only 8-10 biomes in the world ranging from tundras and forests (boreal, temperate, tropical) to grasslands, savannas and scrubs and to deserts. However, there is no single agreed list of the biomes.

Source: IPCC, 2000

Many soil alterations occur slowly over a long term, while others will occur very quickly, such as loss of soil organic carbon (SOC). Loss of SOC causes rapid decreases in the quality of many soil properties such as soil structure and biodiversity. The worldwide amount of SOC bears directly on changes in atmospheric carbon. Modest changes in SOC, whether positive or negative, may have an appreciable effect on the content of atmospheric carbon, whose yearly change is only a small percentage of the total SOC (Kimble, Lal & Grossman, 1998).

The effects of climate change on erosion risk is discussed in the section "What is happening to Europe's soil?".

Soil as a carbon sink

The capability of soil to sequester atmospheric carbon could be exploited to offset greenhouse emissions due to the burning of fossil fuels, and is currently under discussion in the framework of the United

2000).

Terrestrial sinks are part of an active biological cycle, so that a substantial fraction of the fossil fuel carbon sequestrated currently by terrestrial ecosystems could return to the atmosphere in one hundred years or so. Thus, terrestrial sinks are best viewed as important but temporary reservoirs that can buy valuable time to reduce industrial emissions, but they are not permanent offsets to these emissions.

Within terrestrial ecosystems, current carbon stocks are much larger in soil than in vegetation, particularly in non-forested ecosystems in middle and high latitudes. In boreal forests, for example, carbon stocks in soil are five time higher than stocks in vegetation (Table 1, IPCC, 2000).

Moreover, below-ground carbon generally has a slower turnover than above-ground carbon. Thus, carbon storage can be maintained over a longer period of time.

Box 4: Soil and climate change continued

Below-ground carbon is normally more protected than above-ground carbon during fires and other disturbances (IGBP, 1998).

Agricultural practices have a significant influence on the amount of carbon stored in soil over time. Changes in agricultural practices and inputs- notably changes in crop varieties, application of fertilisers and manure, rotation and tillage practices - influence how much and at what rate carbon is stored in or released from soils (Ringius, 1999).

Carbon sequestration and soil degradation
Conservation-effective land use and soil management systems offer a potential for carbon sequestration in soil and terrestrial ecosystems through decrease in losses of soil organic carbon and increase in biomass production, among other benefits. (Lal and Kimble, 1998)

Within this context, there is a clear economic linkage between fossil fuel burning, climate change, dryland degradation and carbon flux. Carbon sequestration may be viewed as the key to reversing soil degradation; as degradation is reversed, so carbon sequestration increases and vice-versa.

The projected opportunities for carbon sequestration in drylands over the next five to 50 years suggest that if conservation and rehabilitation measures were implemented in the world's drylands, this would lead to an annual carbon sequestration between 1.0 to 1.3 Gt per year (UNEP, 1995, Squires, 1998).

These considerations will become relevant once the Kyoto Protocol[5]is ratified by allowing trading of carbon credits and cooperation between Annex I (developed) and non-Annex I countries in reducing net emissions through the Clean Development Mechanism (CDM).

Box 5: Soil degradation in central and eastern Europe(CEE), including new independent states (NIS)

Soil problems in CEE countries are in principle not different from the problems of soils in the EU. Nevertheless, the economic crisis which followed the collapse of the former Soviet Union has resulted in lower pressures on the environment in general and on soil in particular. As the economies recover, an increase of impacts on soil can be expected, following similar trends to those that have been observed in the EU in past decades, if proper measures are not taken. However, the effects of mismanagement of soil in the past have not been eliminated and still limit access to the resource today.

Specific aspects of soil degradation in CEE countries include:

- uncontrolled management of polluting materials (oil, organic toxic compounds, military waste material, heavy metals);
- reduced agricultural pollution in comparison with the EU (lower use of fertilizers, due to economic conditions);
- contamination, erosion, salinization, waterlogging and destruction caused by oil spills.

In the NIS, soil problems are linked to the overuse of small areas due to reduced fertility and functionality of larger areas, caused by problems such as water and wind erosion, soil compaction, overgrazing, salinisation and waterlogging. In specific areas, soil degradation can be severe, and includes contamination by heavy metals, persistent organic pollutants (POPs) and dioxins around industrial sites and urban areas, oil spills and contamination by radionuclides. Pressures on small plots are also caused by the abandonment of cultivation in larger agricultural estates due to lack of economic resources, technical facilities and manpower.

Quantification of the problem, in particular in the NIS, is difficult due to lack of comparable and reliable data, since methods that have been used to collect and assess data are not reported. This is the major limitation in producing a sound assessment on the basis of available information.

[5]The Kyoto Protocol of the UN-FCCC recognises the need to consider additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the categories of agricultural soils, land-use change and forestry (UNFCCC, 1998).

Since 1990, progress has been made in regulating activities related to forestry (afforestation, reforestation and deforestation) in the so-called "Kyoto forests". At present, there is a growing pressure to include soil conservation in the project portfolio recognised and regulated under the protocol (Ringius, 1999).

estimated that 5 million ha of arable land are strongly acidified although treated with lime (National Report of Russia, 1992). Acidification of soils is also observed in Poland, where nearly 25% of soils have a pH less than 4.5, despite an increase in liming (Korytkowsky and Wojewódzki, 1993).

Although there has been a reduction in emissions and use of some hazardous substances, mainly due to application of policy measures, these are countered by a general increase in economic activity. Use of pesticides has slightly decreased in most EU countries over the past decade, probably due to the Common Agricultural Policy (CAP) reforms in 1992 (EEA, 2000). In CEE countries, the use of agrochemicals – which saw a dramatic increase during the 1970s and 1980s in the large collective farms – is currently decreasing, following the collapse of centrally controlled economies. For example, in the Russian Federation use of mineral fertilisers in 1997 was about 20% of the 1990 level (OECD, 1999). Over the next decade, slight increases in pesticide emissions are expected in the EU, while a large increase is expected in accession countries, due to the intensification of agricultural production (EEA, 1999a).

Location of problem areas for local diffuse contamination, and acidification is shown in the next section.

Box 6: An increasing public awareness of soil problems. The role of the media and new information tools.

Recently there has been an increasing interest in soil problems from the mass media in Europe. Examples from Italy and the UK are discussed here. In general, reported concerns are related to loss of revenue and property caused by contamination or identified environmental risks. Cases taken up by the press are usually concerned with local contamination, where a more direct link between the source of contamination and the contamination itself exists, as well as cases involving important economic losses (Sunday Times, 2000b; Rai, 2000a; Repubblica, 2000a).

However, people still underestimate the risk or the real cost of living in an area at risk (whether this is an area close to a landfill or to a factory releasing substances causing cancer, or an area subject to natural risks, such as flooding, landslides or natural radiation). The Environment Agency of England and Wales, for example, estimates that only one person out of 20 living in flood risk areas takes the risk seriously enough to prepare themselves, their family and homes before floods happen. Annual public awareness campaigns are implemented to develop the public's understanding of risk (EA, 2000a).
In most of the cases, this may be in part explained by psychological reasons as well as by the fact that the effects on human health and ecosystems are often delayed. When such impacts occur, it is generally difficult to make a clear link between causes and effects. Moreover, the impacts of soil degradation are often shown indirectly through, for example, the effects on other resources such as the contamination of groundwater.

Nevertheless, public awareness is growing. Catastrophic events such as the recent floods in Italy and the UK (Autumn 2000) have contributed to the public being increasingly aware of the need for a more rational use and a more effective protection of soil and land resources. The causes of these disasters have been clearly identified and reported in the media as stemming from the competition of concurrent uses of land due to a high concentration of population and activities and not simply due to natural hazards[6] (Repubblica, 2000b,c) (Rai, 2000b).

This awareness is perhaps related to the increasing attention provided by the media to soil problems and to the fact that public authorities, NGOs and private companies (e.g. insurance companies) are providing more effective tools to inform the public. In the UK, for example, it is possible to access on-line information on the risks affecting a particular property. New websites have compiled official environmental data about every home in England and Wales. This information is expected to have significant effects on property prices (Sunday Times, 2000c) (EA, 2000c).

[6] In Italy, for example, where floods and landslides are recurrent events, the density of population in 1997 was more than 60% higher than the EU average, with peaks of more than 300% in some regions. The UK has one of the highest density in Europe, equal to twice the EU average (Eurostat New Cronos data).

Where are the "hot spots" of soil degradation in Europe?

Setting up priorities for intervention

As already mentioned in the previous sections, while there may not be severe widespread soil degradation (especially soil contamination) in Europe, there are many localised areas where intense degradation is known to exist (hot spots). The nature of this problem is not well defined due to lack of data. An initial assessment has been carried out using information available on the various forms of degradation (e.g. location of potentially contaminated sites and current rates of erosion) and socio-economic data (e.g. location of population and industrial activities). Where information about actual degradation was not available, proxy datasets have been used.

Due to current data limitations, the results shown here can only provide an overview and give an indication on where the major problems are most likely located, and what they are. They may also show the existing competition among concurrent soil uses and their major threats to soil and the environment (impacts). However, the exact extent of the degraded area is not easily portrayed in the maps included in this section; rather, they serve to indicate where problems are occurring and their possible extent.

A future European monitoring programme could take these "hot spots" as a starting point for defining monitoring priorities, for which a more detailed assessment is needed.

Soil sealing

Map 1 shows areas where soil sealing due to urbanisation and construction of infrastructure is high and where the greatest pressures are likely to occur.

Proxy datasets on pressures to soil have been used for the assessment, including the areas in the EU15 classified as 'urban' and 'suburban', the rates of urban expansion that have occurred in the past 50 years in selected European cities and the increase in artificial areas in coastal zones in the period 1975-1990.

Projected changes of urban population on a country basis are also shown (UN population Division, 1996). However, the relation between increase in population and soil sealing are complex. The increase in artificial areas in Europe in the last decades was not due to increase in population in most of the countries, but rather to changes in population behaviour (shift from an intensive to an extensive urban pattern: sub-urbanisation)[6]. Currently, problems of continued soil sealing are located in countries where the projected increase in urban population will be less than 10% over the next 25 years, and are mainly caused by extensive sub-urbanisation.

The Benelux countries and western Germany already have a high degree of urbanisation and sub-urbanisation. Although the projected rate of urbanisation within these countries is quite small in percentage terms, the actual area needed for this change is likely to be substantial. Most of this growth is likely to be within or on the edge of the suburban areas, due both to logistic issues (i.e. the lack of available space within cities, as indicated by the relatively low past rate of urbanisation of some of the cities within these areas) and socio-economic factors (i.e. people's preference for living outside the city centre). On the other side, the highest projected percentage rates of change are seen within countries with still relatively little urbanisation such as Portugal, Finland and Ireland, where the rate of urbanisation over the past 50 years within the cities sampled has also been high. Although the actual area needed for the projected increases may not be very large, the impact on natural areas may actually be greater in relative terms than within those countries that are already highly (sub)-urbanised.

In the Mediterranean countries, urbanisation has been especially rapid in the coastal zones of southern Spain, the Mediterranean

[6] At the global level, population increase remains an inportant factor.

islands, southern France and Italy, and this process is linked with the development of tourism in these areas. With the continuing increase in tourism within Europe, these pressures are likely to remain or increase in the coming years.

Soil erosion

Map 2 shows the location of soil erosion problems occurring in Europe on the basis of published observations and measurements in the field. The map shows regions where the nature of soil erosion (causes and impacts) is broadly similar, the location of "hot spots" within these regions and the associated measured rates of erosion from individual sites within the "hot spot" areas where data are available. It is important to note that the quality of the data used to make the assessment varies greatly.

There are three broad zones of erosion across Europe: a southern zone, a northern loess zone, and an eastern zone. Erosion is also an important problem in Iceland.

In the southern zone, severe water erosion results from intense seasonal rainfall. This is often associated with overgrazing or a move away from traditional crops. Erosion here may be of considerable age. The principal impact is on-site: soil productivity decreases as a result of soil thinning.

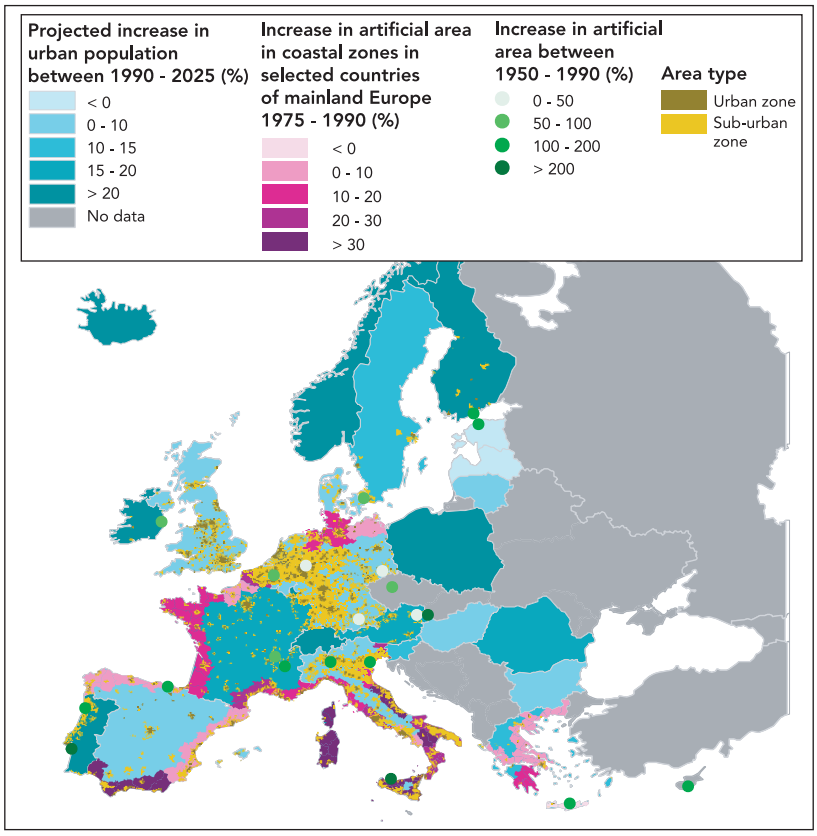
The northern loess zone has moderate rates of water erosion. This mostly results from less intense rainfall falling on saturated, easily erodible soils. There is also local wind erosion of light soils. Impacts in this zone are mainly off-site, as agricultural chemicals from the north's more intensive farming systems are moved into water bodies along with eroded sediment.

Partially overlapping these two zones is the eastern zone, where former large state-controlled farms produced considerable erosion problems. Eroded sediments here may also be contaminated from former industrial operations.

Other, relatively minor, areas of erosion occur outside these zones. Within all three zones, there are 'hot spot areas' where erosion is more serious. However, erosion is patchy in both time and space so that even within a hot spot, eroded fields can be seen side-by-side with untouched areas.

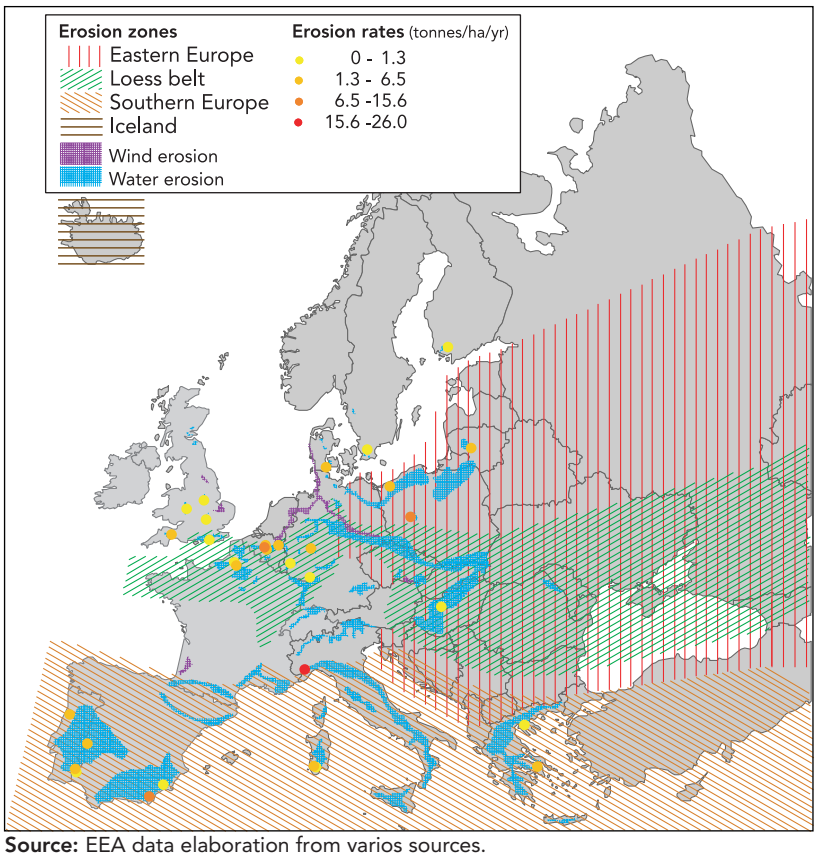
The coverage of reliable measurements of erosion is very patchy, and to an extent reflects the activities of particular workers rather than the severity of the problem.

Probable problem areas of soil sealing in Europe | Map 1



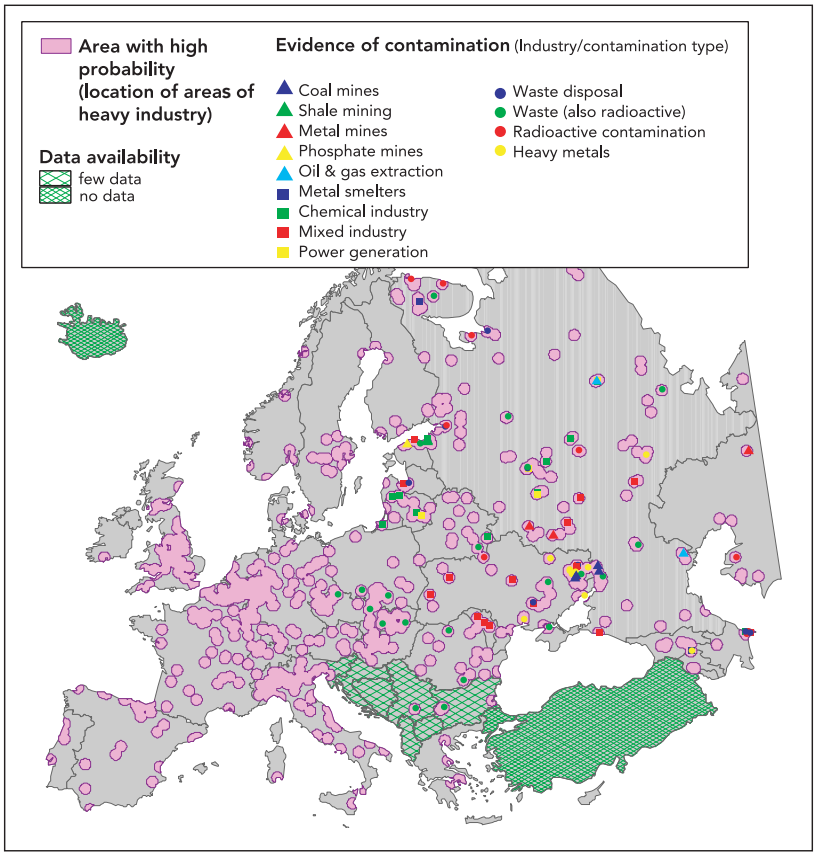
Sources: European Commission (Eurostat, Joint Research Centre); UN Population Division

Map 2 **Probable problem areas of soil erosion in Europe**



Source: EEA data elaboration from varios sources.

Map 3 **Probable problem areas of local contamination in Europe**



Local contamination

Map 3 shows the location of zones with high probability of soil contamination (through heavy industry) and zones where actual soil contamination has been reported. The data used does not cover all countries and may not be complete in the area under study. Since there is no harmonised monitoring of local soil contamination in Europe and many countries do not yet have national inventories (see section on contamination), the map shown here uses as a proxy data set the location of areas of heavy industry.

The areas where the probability of occurrence of local contamination is high are located in North-West Europe, from Nord-Pas de Calais in France to the Rhein-Ruhr region in Germany, across Belgium and the Netherlands. Other areas include the Saar region in Germany; northern Italy, north of the river Po, from Milan to Padua; the region located at the corner of Poland, the Czech Republic and the Slovak Republic, with Krakow and Katowice at its centre (the so-called Black Triangle); and the areas around all major urban agglomerations in Europe.

Diffuse contamination

Map 4 shows areas with high probability of diffuse soil contamination and areas where actual contamination has been reported. For the EU Member States data on chemical use in agriculture has been used as a proxy for diffuse contamination in agricultural areas. In central and eastern European countries an assessment of priority levels for soil contamination has been made, using a subjective classification based on national State of Environment Reports, (Denisov et al., 1997). Consequently all relevant "hot spots" may not have been identified.

The intensity of agricultural chemical use is highest in the lowlands of western Europe: Denmark, the Netherlands, Belgium, Luxembourg, and the north of France. Areas of high livestock manure production are distributed in a more patchy fashion, but the highest proportion is also in North-West Europe. In eastern Europe, problems of

Sources: For EU15: Metal Bulletin Books 1994.
For eastern Europe: Denisov et al., 1997; Mnatsakanian 1992.

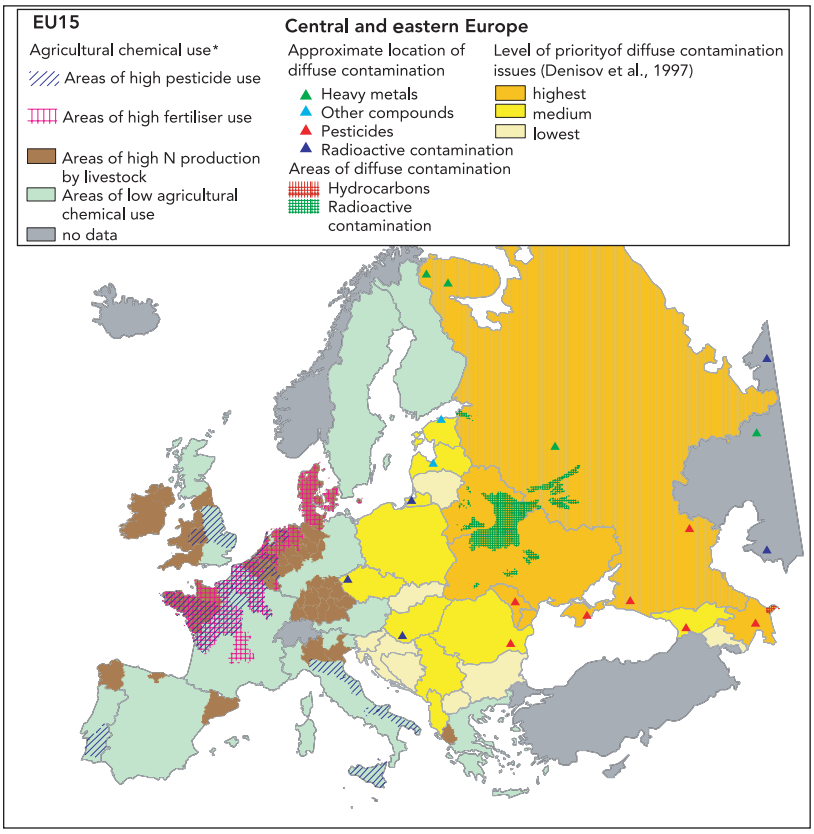
diffuse soil contamination are greatest in Azerbaijan, Belarus, Moldova, Russia and Ukraine.

Acidification and eutrophication

Map 5 shows areas where atmospheric deposition of acidifying nitrogen and sulphur, and eutrophying nitrogen exceeded critical loads for terrestrial ecosystems in 1996.

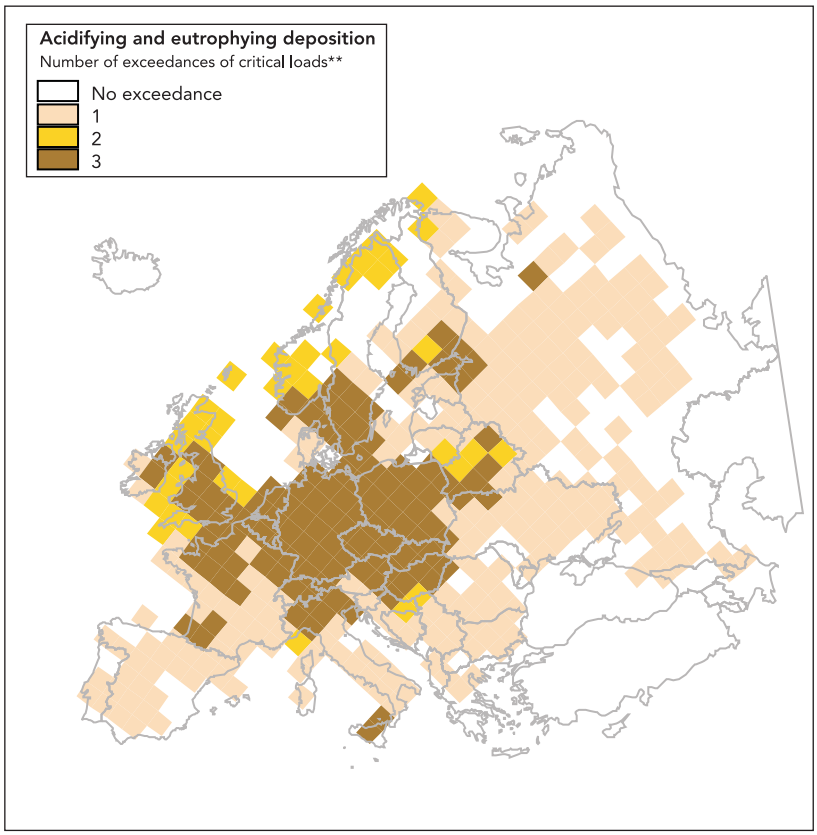
Acidification and eutrophication through deposition from the air occur mainly in north-west and central Europe. It is less of an issue further south and to the east, and to the far north. Critical loads for acidification and eutrophication are exceeded in much of northern Europe. There are very few areas where none of the critical loads are exceeded, and for considerable areas all three critical loads (for acidifying nitrogen and sulphur, and for eutrophying nitrogen) are exceeded.

Probable problem areas of diffuse contamination in Europe — Map 4



Sources: For EU15: New Cronos and Regio databases, EC (1997); FAO (1997)
For eastern Europe: Denisov et al., 1997, Mnatsakanian (1992).

Probable problem areas of acidification in Europe — Map 5



* Classification of intensity of agricultural chemical use for the EU15. These values are averages for region areas, and not actual spreading rates.

Chemical type	'low'	'medium'	'high'
Fertilisers	< 50 kg/ha	50 – 100 kg/ha	> 100 kg/ha
Pesticides	< 1 kg/ha	1 – 2 kg/ha	> 2 kg/ha
Nitrogen production	< 50 kg/ha	50 – 100 kg/ha	> 100 kg/ha

** Critical loads are defined as the amount of deposition of a substance that will cause change to naturally occurring ecosystems. Although the amount by which the critical loads are exceeded varies considerably between areas, the effect of such exceedances very much depends on the ecosystem under consideration. For this reason an attempt at quantifying the effects of critical load exceedances has not been made, but the occurrence of exceedance has been used to identify those areas where effects may be seen. Knowledge of the characteristics of the affected ecosystems as well as the size of the exceedance will be necessary to assess in which areas these exceedances are likely to have the greatest effect.

Sources: EEA data elaboration from EMEP 1996 data

What is being done?

Current initiatives for soil protection

Soil protection in the European Union

Sustainable management of soil as a natural resource, together with air and water, is among the challenges and priorities mentioned in the Fifth Environmental Action Programme (5EAP) (EC, 1993). However, unlike for air and water, soil protection is not usually the subject of specific objectives and targets; rather, it is addressed indirectly through measures directed at the protection of air or water or developed within sectoral policies (secondary protection). Moreover, measures developed for specific sectors without considering the possible effects on soil may lead to its further damage (EEA, 1999a).

Beyond the broad framework of the 5EAP, there is no legislation or funding instrument at EU level which directly addresses soil protection (primary protection). This is in part due to the EU Treaty not providing a specific legal base for soil policy, but in part it is due to soil's own complexity.

However, there is EU legislation indirectly (but not explicitly) concerned with soil protection, including the Directives on Nitrates (91/676/EEC) and Sewage Sludge (82/278/EEC and 91/271/EEC). Existing measures mostly address general soil degradation and contamination due to agricultural activities and local soil contamination due to industrial activities or waste disposal. Soil protection is also part of good agricultural practices, and is implied in the regulation on support for rural development (1257/99/EC, chapter on agri-environment) and the Regulation on common rules for direct support schemes under the Common Agricultural Policy (1259/99/EC, art. 3, environmental protection), which are expected to provide benefits to soil in the coming years.

Many Directorates Generals (DGs) of the European Commission are therefore involved in soil issues, in particular DG Environment, DG Agriculture and DG Regional Policies, which is a result of cross-cutting nature of soil.

At the national level, many EU Member States have produced legislation, policies or guidelines to improve soils or prevent them from further degradation (EEA, 1999a).

The recent initiative put forward by DG Environment and Member States to initiate a European Soil Forum (ESF), with the objective to promote the exchange of information, raise awareness and build a common platform for soil protection in Europe can be considered as a first and important step forward. The ESF includes countries from the EU, central and eastern Europe, and Switzerland.

Water erosion in northern Europe (Wicklow Mountains, Ireland)

International initiatives and legal instruments for soil protection

Within the more than 200 multi-lateral treaties, agreements, conventions and protocols established in the field of environment, covering flora and fauna conservation, pollution management, regional conservation protection, protection of world cultural and natural heritage, landscape protection and many others (UNEP, 1996), only a few of them are directed towards the protection of soil (Hannam and Boer, 1999).

Among them, the European Soil Charter (1972), the World Soil Charter (1972) and the World Soil Policy (1982) need to be mentioned. These instruments have contributed to raising the profile of soil conservation as a major international environmental management issue, but have not resulted in operational programmes to protect soil.

In Agenda 21 of the United Nation Convention on Environment and Development (UNCED), soil as a major natural resource was not specifically mentioned in its various chapters. However, Agenda 21 indirectly addresses soil issues in several chapters on land resources, such as those related to agriculture, sustainable land use, desertification and biodiversity.

Moreover, a number of international conventions addressing soil issues have been ratified since the 1992 Rio Declaration on Environment and Development. These include climate change (UNFCC), biodiversity (UNCBD), desertification (UNCCD), as well as the International Forum on Forests with its International Forest Principles (IFF) and the Global Plan of Action on Land Based Pollution (GPA).

In particular, the UN Convention to Combat Desertification (1994) addresses the impacts of land degradation in arid, semi-arid and sub-humid regions as well regions affected by serious drought. Annex IV to the convention makes provisions for the affected countries of the northern Mediterranean, while a new Annex to the convention (Annex V) is being negotiated and would include central and eastern European countries (UNCCD, 1997).

The convention invites the countries to prepare national action plans (NAPs) as well as a regional action plan to combat desertification in the area. Greece, Italy, Portugal, Spain and Turkey have signed Annex IV, but only Portugal and Italy have presented their NAPs to date.

Soil supports the production of biomass, thus sustaining human and animal life (Arable land near Montalcino, Val d'Orcia – Tuscany)

What is needed to cope with soil problems?

The way forward

Towards a European policy for soil protection

The development of a policy framework which recognises the role of soil, taking account of the problems arising from the competition among its concurrent uses (ecological and socio-economic), and aiming at the maintenance of soil's multiple functions, could have multiple benefits and achieve a consistent improvement of Europe's environment as a whole.

There are appropriate actions to be taken at all administrative levels, from land planning at the local and sub-national levels, to the setting up of environmental and sectoral policies at the national and European levels, and the launch of initiatives on a global scale.

Although land planning and soil management have not been included in the list of policy issues where the European Union has a competence in accordance with the principle of subsidiarity, there is a need to go beyond this competence, to address global problems a broader approach is infact required.

Better information for policy

Data on soil has been gathered by different organisations for different purposes (soil has many users). There are, however, important data gaps and access to relevant data and information is difficult. Few existing data can be directly used for policy purposes and most covers small geographical areas. This may be a consequence of absence of legal requirements for data collection, monitoring and reporting on most soil aspects at the national and European levels.
The specific situation about soil data in Europe can be summarised as follows:

- a mass of data exists at the local level, but few data are of direct use and there are data gaps at the regional level;
- there is a lack of harmonisation of monitoring and data collection activities at the national and regional levels;
- data flows between data collectors and the organisations responsible for reporting have not been established at the national and European levels.

Improving data and information on the state and trends of Europe's soils would require:

- a coherent framework for monitoring and assessment of Europe's soil, including the establishment of a data flow/reporting mechanism on Europe's soils, which will enable a greater knowledge of the policy-relevant issues at the EU level;
- streamlining of existing activities/ collaboration of relevant stakeholders (who does what; how collaboration between existing institutions and organisations can improve Europe's soils). This should include the development of a work programme for soil for the years to come.

Some progress has been made to close data gaps and to produce better information to support policy-making. To this end a framework "*from national monitoring to European reporting*" is being developed by the EEA, together with its EIONET partners and with the support of EC institutions such as the Joint Research Centre and Eurostat.

Conclusions

Soil loss and deterioration in Europe will continue and will probably accelerate if proper and prompt measures are not taken to de-couple the progress of economic sectors and their pressures on the soil resource through the integration of soil protection measures into sectoral policies.

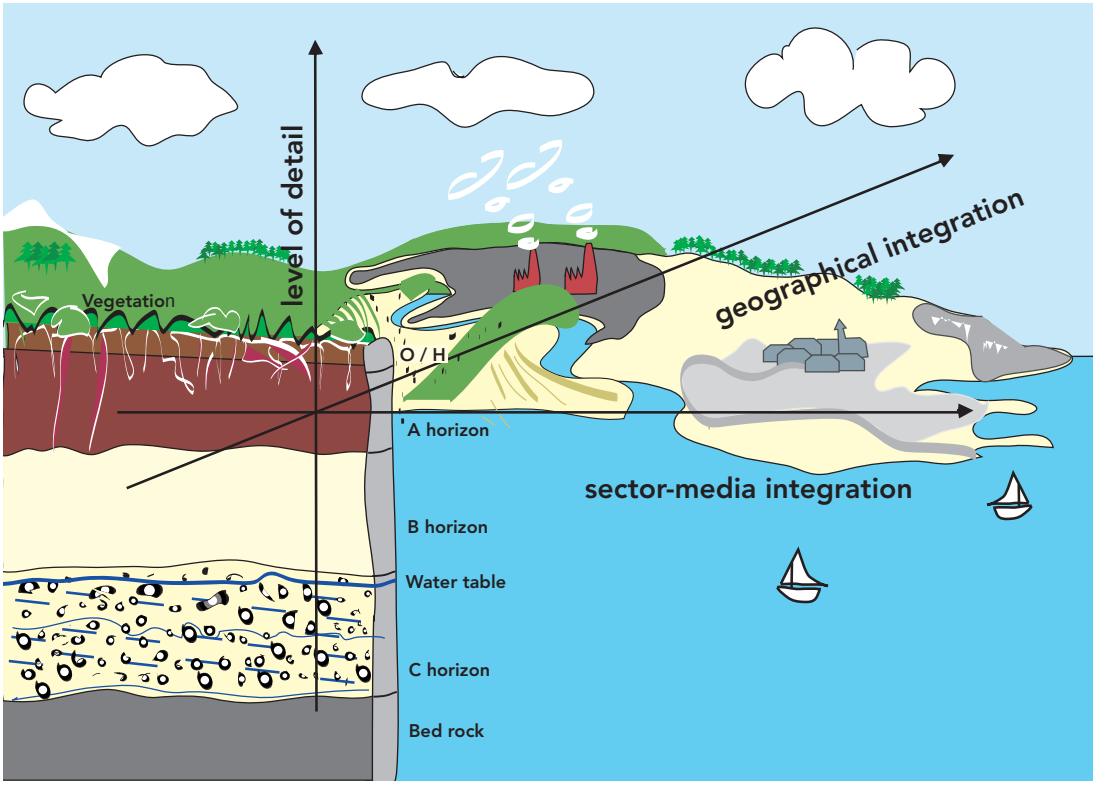
As soil is a cross-cutting issue, soil assessment approaches and soil protection policies need to incorporate a wide perspective. This means that it would be necessary to integrate assessment and responses at the administrative (from global to European and local), sectoral (economic sectors and other environmental issues) and geographical levels (landscapes, urban, rural, mountain and coastal areas) (Fig. 7).

The effects on soil of the implementation of existing measures need to be analysed and monitored. Ideally such results should be communicated on a regular basis through, for example, a soil reporting mechanism based on a European soil monitoring and assessment framework. This would require a closer collaboration among administrations in order to improve access to data and data comparability, and to avoid duplication.

Such assessments would also help identify what else may be necessary but is not covered by existing legislation. Showing the gaps in policy terms will help to increase the awareness of importance of soil protection in sectoral policies and possibly lead to the development of a policy framework which will recognise the central role of soil in Europe's environment.

In the decades to come, the sustainable use of soil will be a great challenge, comparable and closely interrelated with the global concerns about changes in climate and biodiversity. This would require that the necessary actions are taken in order to meet today the diverse and potentially conflicting demands on the soil resource, without compromising its use and availability to future generations.

Integration of soil issues into environmental and sectoral policies Figure 7



Source: EEA, 1999

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