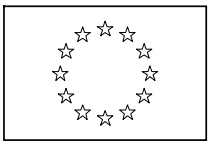

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COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Towards a Thematic Strategy for Soil Protection

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SUMMARY

1. Soil is a vital and largely non-renewable resource increasingly under pressure. The importance of soil protection is recognised both internationally and within the EU. At the Rio summit, the participating states adopted a series of declarations of relevance to soil protection. The aim of the 1994 United Nations Convention to Combat Desertification is to prevent and reduce land degradation, rehabilitate partly degraded land and reclaim partly desertified land. The 6th Environmental Action Programme published by the Commission in 2001 established the objective to protect soils against erosion and pollution while the Sustainable Development Strategy, also published in 2001, noted that soil loss and declining fertility are eroding the viability of agricultural land.

2. The purpose of this Communication is to build on the political commitment to soil protection in order that it be achieved more fully and systematically in coming years. As it is the first communication addressing soil protection, it is both descriptive and action orientated in order that a full picture of the complexity of the issue can be fully understood and it can serve as a basis for future work. A distinction is made between soil, which is the subject of this communication and land use, which will be the subject of a separate communication addressing the territorial dimension to be published in 2003.

3. Soil is generally defined as the upper layer of the earth's crust. It performs a number of key environmental, social and economic functions vital for life. Agriculture and forestry are dependent on soil for the supply of water and nutrients and for root fixation. Soil performs storage, filtering, buffering and transformation functions thus playing a central role in water protection and the exchange of gases with the atmosphere. It is also a habitat and gene pool, an element of the landscape and cultural heritage and a provider of raw materials.

4. In order to perform its many functions, it is necessary to maintain soil condition. However, there is evidence that soil may be increasingly threatened by a range of human activities, which may degrade it. The final phase of the degradation process is land desertification when soil loses its capacity to carry out its functions. Among the threats to soil are erosion, a decline in organic matter, local and diffuse contamination, sealing, compaction, a decline in bio-diversity and salinisation. These threats do not apply evenly across Europe but there is evidence that degradation processes are getting worse. They apply in both current Member States and Candidate Countries. It is likely that climate change will exacerbate them.

5. Many EU policy areas are of relevance to soil and some provide protection for the soil although that is generally not their main focus. Among the policies of most relevance are those relating to Environment, Agriculture, Regional Development, Transport, Development and Research.

6. Knowledge of problems associated with soils is increasing in Europe based on soil surveys, monitoring systems and data networks. This information is very useful but often not comparable, which limits its value for policy development. Nevertheless, available knowledge should be used now, but for the future, it will be necessary to develop an EU wide monitoring system.

7. The development of an EU soil protection policy will take time. It will require a precautionary approach based on preventing soil degradation in the future as well as action through the integration of soil protection aims into several policies both to arrest current soil degradation processes and to deliver protection in the future. This approach will have both a local and EU dimension. For the longer term, it will be necessary to establish a legislative basis for soil monitoring so that a knowledge based approach can be established aimed at delivering soil protection.

8. In order to ensure soil protection, the Commission intends to develop a thematic strategy.

   From 2002 onwards, the Commission will propose a series of environmental measures designed to prevent soil contamination, including legislation related to mining waste, sewage sludge and compost, and, in addition, will pursue integration of soil protection concerns in major EU policies. A progress report will be prepared in mid 2004.

   In addition, and working with Member States, Candidate Countries and relevant stakeholders, the Commission will prepare the ground for a proposal for soil monitoring legislation to be made also in 2004. Furthermore, and also working with relevant partners, it will prepare a communication dealing with erosion, the decline in soil organic matter and soil contamination including recommendations for actions to overcome them.

9. The measures to be presented in the communication and the monitoring proposal outlined above together with the work emanating from them will comprise the thematic strategy for soil protection, thus responding to the draft Council and Parliament decision on the 6 EAP in relation to thematic strategies. The Commission seeks the endorsement of both the European Parliament and Council for the approach it has set out to ensure soil protection.

1. INTRODUCTION

Soil is a vital resource increasingly under pressure. For sustainable development, it needs to be protected.

The importance of soil protection is increasingly recognised internationally. In 1992, at the Rio summit, the participating states adopted a series of declarations of relevance to soil protection. In particular, the concept of sustainable development was agreed and legally binding conventions on climate change, biological diversity and later desertification adopted. The aim of the 1994 Convention to Combat Desertification is to prevent and reduce land degradation, rehabilitate partly degraded land and reclaim desertified land. This Convention recognises the interlinkage between desertification, poverty, food security, loss of biodiversity and climate change. In May 2001, the Commission indicated soil loss and declining fertility as a main threat to sustainable development as it erodes the viability of agricultural land[1].

Against this background, the Community's 6th Environment Action Programme includes a thematic strategy on soil protection with particular attention to preventing erosion, deterioration, contamination and desertification. The purpose of this Communication is to build on this political commitment in order that soil protection be achieved more fully and systematically in coming years by setting out the way towards developing this strategy. However, this Communication is also the first occasion on which the Commission has addressed soil protection for its own sake and therefore it is both broad and descriptive in approach. It addresses inter alia erosion, the decline in soil organic matter and prevention of pollution. It aims in particular to:

- describe the multiple functions of soils
- identify its characteristics relevant to policy development
- identify the main threats to soil
- present an overview of relevant Community policy
- present the current situation regarding soil information and monitoring and identify gaps which need to be filled as a basis for soil protection policy
- establish the policy basis and outline the steps towards the presentation of a thematic strategy on soil protection in 2004.

The Commission considers that soil protection at this stage can best be achieved through a strategy based on

(1) initiatives, now, in environmental policies,

(2) integration in other policies,

(3) soil monitoring, and

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[1] COM (2001) 264

(4) the future development of new actions based on monitoring results.

Together, these actions form the basis for a thematic strategy on soil which relies in the first instance on current knowledge as the basis for action and, in the future, on developing more fully a knowledge basis for future actions.

2. DEFINITION, FUNCTIONS AND DISTINCTIVE FEATURES FOR POLICY DEVELOPMENT

2.1. Definition

Soil is generally defined as the top layer of the earth's crust. It is formed by mineral particles, organic matter, water, air and living organisms[2]. Soil is the interface between the earth (geosphere), the air (atmosphere) and the water (hydrosphere).

While soil is the physical upper layer of what is usually referred to as "land", the concept of "land" is much wider and includes territorial and spatial dimensions. It is difficult to separate soil from its land context. However, this communication focuses on the need to protect the soil layer as such, due to its unique variety of functions vital to life. A separate Communication "Planning and Environment - the Territorial Dimension", is in preparation and will deal with rational land-use planning, as addressed by the 6th Environment Action Programme.

2.2. Functions

Soil performs a multitude of key environmental, economic, social and cultural functions, vital for life.

- *Food and other biomass production*
  Food and other agriculture production, essential for human survival, and forestry are totally dependent on soil. Almost all vegetation including grassland, arable crops and trees, need soil for the supply of water and nutrients and to fix their roots.

- *Storing, filtering and transformation*
  Soil stores and partly transforms minerals, organic matter, water and energy, and diverse chemical substances. It functions as a natural filter for groundwater, the main source for drinking water, and releases CO_2, methane and other gases in the atmosphere.

- *Habitat and gene pool*
  Soil is the habitat for a huge amount and variety of organisms living in and on the soil, all with unique gene patterns. It therefore performs essential ecological functions.

- *Physical and cultural environment for mankind*
  Soil is the platform for human activity and is also an element of landscape and cultural heritage.

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[2] As defined by International Standards Organisations (ISO) in ISO 11074-1 of 1.08.1996

- *Source of raw materials*
  Soils provide raw materials such as clay, sands, minerals and peat.

The first four of these functions are generally interdependent and the extent to which soils perform them is highly relevant to sustainability. When soil is used as a source of raw materials or the land it occupies as support for human activities, its ability to perform its functions may be reduced or changed leading to competition between the functions.

2.3. Distinctive features of soil relevant for policy making

Soil has a number of unique characteristics of particular relevance to policy development:

- Soil is the product of complex interactions between climate, geology, vegetation, biological activity, time and land use. The proportions of its different components, mainly sand, silt and clay particles, organic matter, water and air, as well as the way in which these components form together a stable structure, define a soil's character. Moreover each soil contains a variable number of successive layers, each with a wide range of different physical, chemical and biological properties. As a result soil is an extremely variable medium. Over 320 major soil types have been identified in Europe, with remarkable differences in their chemical and physical properties even at a local level. This diversity suggests a strong local element needs to be built into soil protection policies.

- Soil is essentially a non-renewable resource with potentially rapid degradation rates and extremely slow formation and regeneration processes. The amount of land and thus soil available for food production per person is limited. Where degradation of soil occurs, the overall potential to perform its functions is reduced. Therefore prevention, precaution and sustainable soil management should be at the core of soil protection policies.

- Soil has considerable storage and buffering capacity, closely related to its organic matter content. This applies not only to water, minerals, and gases, but also to a multitude of chemical substances. These include both natural and manmade contaminants, which can build up in soil but whose subsequent release can follow very divergent patterns. Certain contaminants can exceed irreversibility thresholds for storage and buffering capacity unnoticed. Anticipatory policies based on monitoring and early warning systems are essential to prevent damage to the environment and risks to public health.

- Agricultural soil is a precious and limited resource, whose value has frequently been built by man during decades or even centuries. Irreversible degradation of this resource implies not only ruining the main asset of current farmers but also reducing the farming opportunities of future generations. Therefore, soil protection policies need to have a special focus on sustainable use and management of agricultural soils, with a view to safeguarding the fertility and agronomic value of agricultural land.

- Soil is a living medium with an abundant biodiversity. This biological activity contributes to the structure and fertility of soils and is, therefore, central to most of its functions including food production. As little is known about how soil life

reacts to human activities, increased understanding is required while at the same time policy needs to ensure the protection of soil biodiversity for precautionary reasons.

- Unlike air and water, soil as a component of land is generally submitted to property rights.

3. MAIN THREATS TO SOIL IN THE EU AND CANDIDATE COUNTRIES

Due to its wide range of vital functions, maintaining soil condition is essential for sustainability. However soil is under increasing threat from a wide range of human activities, which are undermining its long-term availability and viability.

The threats are complex and although unevenly spread across regions in the EU and accession countries, their dimension is continental. For simplicity they are presented separately below. In real terms, however, they are frequently inter-linked.

When multiple threats occur simultaneously, their effects tend to increase. Ultimately, if not countered, they can result in soil degradation, when soil loses its capacity to carry out its functions. In the EU, an estimated 52 million hectares, representing more than 16% of the total land area, are affected by some kind of degradation process. In the accession countries this figure is 35% (World map of the status of human induced Soil Degradation (GLASOD), 1990[3]).

Soil degradation, when occurring in dry areas, is known as desertification. It is caused by climatic conditions (droughts, aridity, irregular and intense precipitation regimes) and human activity (deforestation, overgrazing, soil structure deterioration). The affected land can no longer support vegetation. According to the World Atlas of Desertification (UNEP, 1992[4] and EC, 1994[5]) areas under desertification risk include central and southeast Spain, central and southern Italy, southern France and Portugal and extensive areas of Greece. World-wide desertification has extremely serious socio-economic consequences and can ultimately cause the destabilisation of societies and the migration of human populations.

Climate change presents an overarching but as yet uncertain factor linked to degradation processes.

3.1. Erosion

Erosion is a natural geological phenomenon resulting from the removal of soil particles by water or wind, transporting them elsewhere. However, some human activities can dramatically increase erosion rates. Serious erosion is generally irreversible.

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3 EEA data from: United Nations Environment Programme and International Soil Reference and Information Centre, 1992. GLASOD project. World map of the status of human-induced soil degradation. Winand Staring Centre, Wageningen, the Netherlands.

4 United Nations Environment Programme, 1992. World Atlas of Desertification. Edward Arnold, London.

5 European Commission, 1994. Report on Desertification and Land degradation in the European Mediterranean.

Erosion is triggered by a combination of factors such as steep slopes, climate (e.g. long dry periods followed by heavy rainfall), inappropriate land use, land cover patterns (e.g. sparse vegetation) and ecological disasters (e.g. forest fires). Moreover, some intrinsic features of a soil can make it more prone to erosion (e.g. a thin layer of topsoil, silty texture or low organic matter content).

The results of soil erosion are the loss of soil functions and ultimately the loss of soil itself. In more than one third of the total land of the Mediterranean basin, average yearly soil losses exceed 15 tons/ha[6]. Consequent damage to watercourses follows, through the contamination of river and sea aquatic ecosystems by nutrients and contaminants attached to the eroded soil, with additional other effects such as damage to water reservoirs and ports.

Although the Mediterranean region is historically the most severely affected by erosion - the first reports of soil erosion in the Mediterranean date from 3.000 years ago - there is growing evidence of significant erosion occurring in other parts of Europe (e.g. Austria, Czech Republic and the loess belt of Northern France and Belgium). Soil erosion can therefore be considered, with different levels of severity, an EU-wide problem.

According to expert estimates based on non-standardised data (World Map of the Status of Human Induced Soil Degradation (GLASOD), 1990), 26 million hectares in the EU suffer from water erosion and 1 million hectares from wind erosion. Furthermore predictive modelling on erosion risk is under development and has contributed to maps assessing erosion risks for Europe (CORINE[7] programme) and more recently for Italy (JRC[8]) and Europe (JRC[9]). The output of this modelling is still highly uncertain because it has not been validated sufficiently in field situations.

Although there are no comprehensive studies of the economic impact of erosion, available data suggest this is a major challenge. In a 1991 study[10] the direct cost impact of erosion in Spain was estimated at ECU 280 m per year, including the loss of agricultural production, impairment of water reservoirs and damage due to flooding. In addition the cost of attempts to fight erosion and restore the soil were estimated at about ECU 3,000 m over a period of 15 to 20 years**.**

3.2. Decline in organic matter

Soil organic matter is composed of organic material (plant root remains, leaves, excrements), living organisms (bacteria, fungi, earthworms and other soil fauna) and humus, the stable end-product of the decomposition of organic material in the soil by the slow action of soil organisms. As such it is constantly built up and decomposed, so that carbon is released to the atmosphere as CO_2 and recaptured through the process of photosynthesis.

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6 Guidelines for erosion and desertification control management. United Nations Environment Programme, 2000.

7 Commission of the European Communities, 1991. CORINE-Soil erosion risk and land resources in the southern regions of the European Community

8 Estimation of the erosion risk in Italy. European Soil Bureau, Joint Research Centre, 2000.

9 Soil Erosion Risk in Europe. European Soil Bureau, Joint Research Centre, 2001.

10 ICONA, 1991. Plan national de lutte contre l'érosion. Ministère de l`Agriculture, de la Pêche et de l`Alimentation. Institut National pour la Conservation de la Nature, Madrid.

Organic matter plays a central role in maintaining key soil functions and is an essential determinant of erosion resistance and soil fertility. It assures the binding and buffering capacity of soil, thus contributing to limit diffusion of pollution from soil to water.

Farming and forestry practices have an important impact on soil organic matter. Despite the importance of maintaining the organic matter content of soil, there is evidence that decomposing organic matter in the soil is frequently not sufficiently replaced under arable cropping systems which are tending towards greater specialisation and monoculture. Specialisation in farming has led to the separation of livestock from arable production so that rotational practices restoring soil organic matter content are often no longer a feature of farming.

The build-up of organic matter in soils is a slow process (much slower than the decline in organic matter). This process is enhanced by positive farm management techniques such as conservation tillage including no tillage cropping techniques, organic farming, permanent grassland, cover crops, mulching, manuring with green legumes, farmyard manure and compost, strip cropping and contour farming. Most of these techniques have also proven effective in preventing erosion, increasing fertility and enhancing soil biodiversity.

Carbon is a major component of soil organic matter, which in turn plays a major role in the global carbon cycle. Research[11] indicates that approximately 2 gigatonnes (Gt)[12] of carbon is captured (sequestered) in soil organic matter annually. This amount can be compared to the 8 Gt of anthropogenic carbon emitted to the atmosphere annually underlining the importance of soil organic matter in relation to climate change. There is however a limit to the amount of organic matter and hence carbon that can be stored in soils. In addition a dedicated management approach is needed to maintain or increase the soil organic matter content.

Soil organic matter decline is of particular concern in Mediterranean areas. According to the European Soil Bureau, based on the limited data available, nearly 75% of the total area analysed in Southern Europe has a low (3.4%) or very low (1.7%) soil organic matter content. Agronomists consider soils with less than 1.7% organic matter to be in pre-desertification stage. The problem is however not restricted to the Mediterranean. Figures for England and Wales show that the percentage of soils with less than 3.6% organic matter rose from 35% to 42% in the period 1980-1995 probably due to changing management practices. In the same period, in the Beauce region south of Paris, soil organic matter has decreased by half for the same reason.

Because soil organic matter decline is a crosscutting issue which is affecting other areas such as soil fertility and soil erosion, it is extremely difficult to estimate its cost.

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[11] Lal, R., 2000. Soil conservation and restoration to sequester carbon and mitigate the greenhouse effect. III International Congress European Society for Soil Conservation, Valencia.

[12] 1 gigatonne or Gt is 10 billion ton

3.3. Soil contamination

The introduction of contaminants in the soil may result in damage to or loss of some or several functions of soils and possible cross contamination of water. The occurrence of contaminants in soils above certain levels entails multiple negative consequences for the food chain and thus for human health, and for all types of ecosystems and other natural resources. To assess the potential impact of soil contaminants, account needs to be taken not only of their concentration but also their environmental behaviour and the exposure mechanism for human health.

A distinction is often made between soil contamination originating from clearly confined sources (local or point source contamination) and that caused by diffuse sources.

3.3.1. Local soil contamination

Local (or point source) contamination is generally associated with mining, industrial facilities, waste landfills and other facilities both in operation and after closure. These activities can pose risks to both soil and water.

In mining the risk is associated with the storage or disposal of tailings, acid mine drainage and the use of certain chemical reagents.

Industrial facilities both in operation and after closure can be a major source of local contamination. Although the largest and most affected areas are concentrated around the heavily industrialised regions in Northwest Europe, contaminated sites exist everywhere throughout the continent.

Within the EU there are no important areas contaminated with artificial radionuclides. Land contaminated with naturally occurring radioactivity is considered for uranium and other mining tails, phosphogypsum dumps, metal industry, etc.

Waste landfilling is another potentially contaminating activity of major relevance: on average, 65% of municipal waste generated in the EU (190 million tonnes in 1995) is still landfilled. In waste landfills leaching can be emitted to the surrounding soil and soil parent material and subsequently enter groundwater and/or surface water. Of particular concern are those that operate or have operated in the past, without complying with the minimum set of technical requirements set by the Landfill Directive[13].

Estimates of the number of contaminated sites in the EU range from 300 000 to 1.5 million[14]. This wide range in estimations is due to the lack of a common definition for contaminated sites and relates to different approaches to acceptable risk levels, protection targets and exposure parameters.

Soil clean-up is a difficult operation with very high costs. Expenditure for decontamination of contaminated sites greatly varies between Member States. In 2000 the Netherlands invested EUR 550 m in decontamination, Austria 67 and Spain

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13 Council Directive 1999/31/EC

14 European Environment Agency, 1999. Management of contaminated sites in Western Europe.

14. Such disparities reflect different perceptions of the severity of the contamination, different remediation policies and targets, and different ways of estimating expenditure. The European Environment Agency has estimated the total costs for the clean-up of contaminated sites in Europe to be between EUR 59 and 109 billion[15].

Knowledge sharing and targets for clean up are important paths to resolving contamination issues today, but prevention of further contamination needs to be the future objective.

3.3.2. Diffuse soil contamination

Diffuse pollution is generally associated with atmospheric deposition, certain farming practices and inadequate waste and wastewater recycling and treatment.

Atmospheric deposition is due to emissions from industry, traffic and agriculture. Deposition of airborne pollutants releases into soils acidifying contaminants (e.g. SO_2, $NO_{x)}$, heavy metals (e.g. cadmium, lead arsenic, mercury), and several organic compounds (e.g. dioxins, PCBs, PAHs).

Acidifying contaminants gradually decrease the buffering capacity of soils leading them in some instances to surpass their critical load resulting in a sudden massive release of aluminium and other toxic metals into aquatic systems. In addition, acidification favours the leaching out of nutrients with subsequent loss of soil fertility and possible eutrophication problems in water and excess of nitrates in drinking water. Moreover it may damage beneficial soil micro-organisms, slowing down biological activity.

Ammonia and other nitrogen deposition (resulting from emissions from agriculture, traffic and industry) causes the unwanted enrichment of soils and subsequent decline of biodiversity of forests and of high nature value pastures. In some European forests the nitrogen input reaches extreme values of up to 60 kg N per hectare per year. Pre-industrial deposition was below 5 kg[16].

With regard to radioactive substances forest soils deserve particular attention. The characteristic cycling of nutrients in a forest ecosystem implies that for many radionuclides (e.g. caesium-134 and -137 as released by the Chernobyl accident) there is no elimination of radioactive substances (except by radioactive decay). Thus we are today still confronted with levels of radioactivity in forest produce above the maximum permitted levels, especially in wild mushrooms.

A number of farming practices can also be considered as a source of diffuse soil contamination, although their effects on water are better known than on soil.

Production systems where a balance between farm inputs and outputs is not achieved in relation to soil and land availability, leads to nutrient imbalances in soil, which frequently result in the contamination of ground- and surface water. The extent of nitrate problems in Europe underlines the seriousness of this imbalance.

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15 idem 13

16 United Nations Economic Commission and European Commission, 2000. Forest Condition in Europe. 2000 Executive Report.

An additional problem relates to heavy metals (e.g. cadmium, copper) in fertilisers and animal feed. Their effects on soil and soil organisms are not clear, although studies have shown the possible uptake of cadmium in the food chain. The effects on soil of antibiotics contained in animal feed are unknown.

Pesticides are toxic compounds deliberately released into the environment to fight plant pests and diseases. They can accumulate in the soil, leach to the groundwater and evaporate into the air from which further deposition onto soil can take place. They also may affect soil biodiversity and enter the food chain.

The current authorisation process of pesticides[17] assesses inter alia the environmental risks of individual pesticides in the soil, however information on the combined effects remains limited. By this authorisation process pesticides with unacceptable risks are being eliminated. The volume of pesticide active ingredients sold across the 15 EU Member States reached 321,386 tonnes in 1998[18].

While the use of pesticides is regulated, and they should be only applied following Good Farming Practice, pesticides have been found to leach through the soil into groundwater and to be eroded with soil into surface water. Accumulation in soil occurs, in particular of those compounds now prohibited in the EU.

With regard to waste, sewage sludge, the final product of the treatment of wastewater, is also raising concern. It is potentially contaminated by a whole range of pollutants, such as heavy metals and poorly biodegradable trace organic compounds, what can result in an increase of the soil concentrations of these compounds. Some of them can be broken down to harmless molecules by soil micro-organisms whereas others are persistent including heavy metals. This may result in increasing levels in the soil with subsequent risk for soil micro-organisms, plants, fauna and human beings. Potentially pathogenic organisms like viruses and bacteria are also present. However sewage sludge contains organic matter and nutrients such as nitrogen, phosphorus and potassium, of value to the soil and the options for its use include application on agricultural land. Provided that contamination is prevented and monitored at source, the careful and monitored use of sewage sludge on soil should not cause a problem, and, indeed, on the contrary could be beneficial and contribute to an increase of soil organic matter content. 6.5 million tonnes of sludge (dry matter) are produced every year in the EU. It is estimated that by 2005 there will be a 40% increase in the total quantity of sewage sludge available due to the progressive implementation of the Urban Wastewater Directive[19]. A recent implementation report by the Commission[20] on the latter indicates progress but also major delays in the implementation of that Directive in most Member States.

The cost of diffuse soil contamination is not seen so much in soil itself, but in the consequences of the breakdown of the buffering capacity of soil. Although the precise cost has not been counted so far, the clean up of organic compounds, pesticides, plant nutrients and heavy metals from water is known to be very costly.

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17 Council Directive 91/414/EEC

18 Eurostat, 2001. NewCronos database, Theme 8: Environment and Energy, Domain Milieu: Environment statistics, Collection: Agriculture, Table SAL_PEST: Sales of pesticides (tonnes of active ingredient)

19 Council Directive 91/271/EEC

20 COM (2001) 685

3.4. Soil sealing

The covering of soil for housing, roads or other land developments is known as soil sealing. When land is sealed, the area for soil to carry out its functions including the absorption of rainwater for infiltration and filtering is reduced. In addition sealed areas may have a great impact on surrounding soils by changing water flow patterns and by increasing the fragmentation of biodiversity. Soil sealing is almost irreversible.

Developments in soil sealing are largely determined by spatial planning strategies where unfortunately the effects of irreplaceable soil losses are often not sufficiently taken into account. A paramount example is the coastal areas in the Mediterranean where the share of zones completely free from construction is in permanent decline. In 1996, nearly 43% of the area in coastal zones in Italy, generally containing fertile soils, was completely occupied by built-up areas and only 29% was completely free from constructions.

As for other threats to soil, there is a lack of European-wide information: data on the extent of built-up areas are only available for a limited number of countries, and many of these data are not comparable since countries use different methodologies.

Equally, there is no information about the type of soil being sealed. A decrease in some soil availability is inevitable, but if the sealed soil plays a valuable role in food production, nature conservation, flood control or any other key function, then the consequences of sealing are damaging to sustainable development.

3.5. Soil compaction

Soil compaction occurs when soil is subject to mechanical pressure through the use of heavy machinery or overgrazing, especially in wet soil conditions. In sensitive areas, walking tourism and skiing also contribute to the problem. Compaction reduces the pore space between soil particles and the soil partially or fully loses its absorptive capacity. Compaction of deeper soil layers is very difficult to reverse.

The overall deterioration in soil structure caused by compaction restricts root growth, water storage capacity, fertility, biological activity and stability. Moreover, when heavy rainfall occurs, the water can no longer easily infiltrate the soil. Resultant large volumes of run-off water increase erosion risks and are considered by some experts to have contributed to some recent flooding events in Europe[21].

It has been estimated that nearly 4% of soil throughout Europe suffers from compaction[22], but no precise data are available.

3.6. Decline in soil biodiversity

Soil is the habitat for a huge variety of living organisms. In addition the character of all terrestrial ecosystems is heavily dependent on the soil type. Soil type determines to a great extent the ecosystems found in an area, many of them of great ecological value (wetlands, flood plains, peatlands). The largest quantity and variety of life is

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21 European Environment Agency, 2001. Sustainable water use in Europe.

22 Idem 3

found in the soil itself. In a pasture, for each 1 to 1.5 tons of biomass living on the soil (livestock and grass), about 25 tons of biomass (bacteria, earthworms and so on) are in the first 30 cm of soil underneath.

Soil bacteria, fungi, protozoa and other small organisms play an essential role in maintaining the physical and biochemical properties needed for soil fertility. Larger organisms, worms, snails and small arthropods break up organic matter which is further degraded by micro organisms, and both carry it to deeper layers of soil, where it is more stable. Furthermore soil organisms themselves serve as reservoirs of nutrients, suppress external pathogens and break down pollutants into simpler, often less harmful components.

Reductions in soil biodiversity make soils more vulnerable to other degradation processes. Therefore soil biodiversity is often used as an overall indicator of the state of soil health. One gram of soil in good condition can contain up to 600 million bacteria belonging to 15,000 to 20,000 different species. In desert soils these numbers decline to 1 million and 5,000 to 8,000 species respectively.

Although the complexity of soil biodiversity dynamics is not yet fully understood, there is evidence that biological activity in soils is largely dependent on the occurrence of appropriate levels of organic matter. The inappropriate use of pesticides and in particular nematicides can have very negative effects because of their poor selectivity. Some studies suggest that some herbicides considerably suppress soil bacteria and fungi activity. Moreover, excessive use of nutrients can also seriously alter biological balances and thus reduce soil biodiversity.

Organic farming has been shown to be very effective preserving and enhancing biodiversity. In a two-year study in Austrian soils, beetles were 94% more abundant in organic fields than in the conventional ones. The number of beetle species was 16% higher. However, it is stressed that quantification of soil biodiversity is extremely limited and confined to projects of local relevance.

As the main effects of loss of biodiversity are indirect, the estimation of its economic costs is not possible at this stage.

3.7. Salinisation

Salinisation is the accumulation in soils of soluble salts of sodium, magnesium, and calcium to the extent that soil fertility is severely reduced.

This process is often associated with irrigation as irrigation water always contains variable amounts of salts in particular in regions where low rainfall, high evapotranspiration rates or soil textural characteristics impede the washing out of the salts which subsequently build-up in the soil surface layers. Irrigation with high salt content waters dramatically worsens the problem. In coastal areas salinisation can also be associated with groundwater overexploitation (caused by the demands of growing urbanisation, industry and agriculture) leading to a lower water table and triggering the intrusion of marine water. In nordic countries the winter maintenance of roads with salts can lead to salinisation.

Soil salinisation affects an estimated 1 million hectares in the EU, mainly in the Mediterranean countries and is a major cause of desertification. In Spain 3% of the

3.5 million hectares irrigated land is severely affected, significantly reducing its agricultural potential, and another 15 % is under serious risk[23]. There is no estimation on the total economic cost of this phenomenon.

3.8. Floods and landslides

Floods and landslides are mainly natural hazards intimately related to soil and land management. Floods and mass movements of soil cause erosion, pollution with sediments and loss of soil resources with major impacts for human activities and human lives, damage to buildings and infrastructures, and loss of agricultural land.

Floods and landslides are not a threat to soils in the same manner as the threats already listed. However, floods can, in some cases, result in part from soil not performing its role of controlling the water cycle due to compaction or sealing. They may also be favoured by erosion often caused by deforestation or by abandonment of land.

Such events are occurring more frequently in areas with highly erodible soils, steep slopes and intense precipitation, such as the Alpine and the Mediterranean regions[24]. In Italy 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[25]**.**

The impacts on population and the economic damage are relevant. In Italy in the last 20 years floods and landslides had an impact on more than 70 000 people and caused economic damage of at least EUR 11 billion.

3.9. The situation in Candidate Countries

Threats to soils in Candidate Countries are essentially similar to those described in the EU.

The most recent expert assessment on the situation of soils in Central and Eastern European Countries is the SOVEUR report[26] by FAO. According to this report, the situation in soil threats in some candidate countries can be summarised as follows.

Erosion is a major environmental issue, although there are significant differences between countries regarding its extent and intensity. Areas affected range from 5% to 39% of the total surface.

Local contamination associated with the 3000 former military facilities constitutes a major problem not yet fully evaluated.

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23 Programa de Acción Nacional Contra la Desertificación (Borrador de Trabajo). Ministerio de Medio Ambiente. Madrid, Marzo, 2001.

24 Down to earth: soil degradation and sustainable development in Europe. European Environment Agency 2000.

25 Ministry of the Environment. Classificazione dei Comuni italiani in base al livello di attenzione per il rischio idrogeologico. Monography. Collana della Relazione sullo Stato dell'Ambiente, Italy, 2000

26 Van Lynden , G.W., 2000. Soil degradation in Central and Eastern Europe: The assessment of the status of human-induced soil degradation. FAO-ISRIC, Rome

Several forms of **diffuse contamination** have been reported. Acidification is affecting about 35% of Poland and Hungary, Latvia and Lithuania are also affected. 40% of Lithuania has high heavy metal concentrations, but this may be strongly influenced by extremely high natural background concentrations.

Soil compaction is widespread particularly in Bulgaria.

In Hungary 8% of the territory is affected by **salinisation,** mostly of natural origin. In the other candidates countries it does not appear to be a major problem.

There are no figures on **soil sealing**, **organic matter**, **biodiversity** and **floods and landslides**.

No figures on the economic and environmental implications of soil degradation in candidate countries are available.

3.10. Conclusions on soil threats

A series of common threads link together many of the threats and some conclusions can be drawn.

- Soil degradation processes are driven or exacerbated by human activity and are damaging the capacity of soil to continue performing its broad variety of functions.

- Although they are not equally relevant in all countries, there is evidence that soil degradation processes are currently taking place in the European Union.

- There is no evidence of significant reversal in negative trends in degradation processes. On the contrary, the information available suggests that, over recent decades, there has been an increase of some degradation processes.

- While there is no conclusive evidence on the effects of climate change on soil, it appears likely that it will increase the potential of the threats. This in turn suggests that soil protection will be of increasing importance in the future.

When linked together, the degradation processes described often undermine soil sustainability. Although no overall estimate of degradation costs exist, it is clear that the economic consequences of degradation and the cost of decontamination are substantial. Information now available allows the design of some initiatives to stop and revert soil degradation. However more detailed and comparable information on the extent and significance of the degradation processes, as well as on the most appropriate soil management practices and soil protection measures, is necessary to improve the prevention of degradation processes for the future.

4. THE INTERNATIONAL DIMENSION

Soil degradation processes are not confined to the European Union but constitute a major worldwide problem with significant environmental, social and economic consequences. As world population increases the need to protect soil as a vital resource particularly for food production is increasing. Growing awareness in the

international community of the need for global responses has lead to an increasing number of international initiatives.

The 1972 Council of Europe's Soil Charter called on states to promote a soil conservation policy. The World Soil Charter (FAO 1982) and the World Soils Policy (UNEP 1982) sought to encourage international co-operation in the rational use of soil resources. The UNEP Environmental Guidelines for the Formulation of National Soil Policies set out a procedure for preparing national policy with a built-in sustainable land use element.

At the Earth Summit in Rio de Janeiro in 1992, the international community agreed on a global partnership for sustainable development and established the Agenda 21 framework. As a result of that several conventions were launched.

The 1992 Framework Convention on Climate Change (CCC) recognises the role and importance of terrestrial ecosystems as sinks of greenhouse gases and that land degradation problems and changes in land use can exacerbate the emission of gases to the atmosphere. The 1997 Kyoto Protocol promotes sustainable development and calls on each Party to implement policies and measures to protect and enhance sinks and reservoirs of greenhouse gases. In March 2000 the Commission adopted a communication on EU policies and measures to reduce greenhouse gas emissions "Towards a European Climate Change Programme" (ECCP)[27]. The ECCP activity covers several areas including now soils as sinks. The report on work in this area will be completed during 2002.

The 1992 Convention on Biological Diversity (CBD) aims to conserve biological diversity, encourage the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources. Fundamental to the CBD is the concern that biological diversity is being significantly reduced by human activities, including soil and land management. In several Conferences of the Parties of the Convention, decisions[28]have been taken aiming at the protection of soil biodiversity and reduction of the negative effect on it of certain agricultural practices including the excessive use of inputs.

The European Community Biodiversity Strategy[29] and its recently adopted Action Plans set out the framework for developing Community policies and instruments in order to ensure Community compliance with commitments given under the CBD. In particular, the Action Plan for the Conservation of Natural Resources includes an action establishing an information base on soil erosion, organic matter and heavy metals and monitoring urbanisation in relation to biodiversity.

The 1994 Convention to Combat Desertification (CCD)[30] acknowledges that arid, semi-arid and dry sub-humid areas together account for a significant proportion of the earth's land area and represent the habitat and source of livelihood for a large segment of its population. The objective of the CCD is to prevent and reduce land degradation, rehabilitate partly degraded land and reclaim desertified land through effective actions supported by international co-operation and agreements.

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27 COM (2000) 88

28 For instance Decisions III/11 and V/5

29 COM(1998) 42

30 http://www.unccd.int

The CCD contains five regional annexes covering Africa, Asia, Latin-America and the Caribbean, the Northern Mediterranean (relevant for four Member States: Greece, Italy, Portugal and Spain) and Central and Eastern Europe (relevant for most Candidate Countries). The elaboration and implementation of Regional Action Programmes and National Action Programmes, form valuable policy instruments to combat desertification and soil degradation phenomena in the affected areas.[31] Furthermore, the Committee of Science and Technology, a subsidiary body within the Convention produces a significant amount of information and advice on scientific and technological matters relating to land degradation worldwide.

In 1999, following a joint initiative of the Commission and some Member States (Bonn Memorandum on Soil Protection Policies in Europe, 1998) the European Soil Forum (ESF) was created. Its membership includes EU, EFTA and Accession Countries, the Commission and the EEA. Its role is to provide a better understanding of soil protection issues and to promote the exchange of information among participating countries. It aims to bring the discussion on soil protection from the scientific and technical level to the administrative and policy area.

5. ACTION TAKEN BY MEMBER STATES AND CANDIDATE COUNTRIES

Individual Member States have taken different initiatives on soil protection aimed at those soil degradation processes they considered as priorities.

In central and northern Europe efforts focus on soil contamination and sealing, while in the southern countries initiatives concentrate on erosion and desertification in the context of the UN Convention to Combat Desertification (UN-CCD). Portugal, Greece, Italy and Spain have adopted National Action Plans to combat desertification, in which they analyse the desertification process and identify actions to be undertaken.

The Spanish plan has concluded that 31% of Spain is under serious threat of desertification. The plan has launched actions regarding sustainable management of water resources, forest fire prevention and experimental stations on desertification.

The Greek National Action Plan describes the desertification problem in Greece and proposes measures for its prevention and control. The Portuguese plan focuses on soil and water conservation. It targets measures for the recovery of degraded areas to ensure that the population remains in the more depopulated areas.

The Italian plan focuses on reducing the risk of floods and landslides. It relates to the regulation of water use and the co-ordination of the sectoral policies that have an impact on the water cycle. High risk areas for floods and landslides have been defined.

Some Member States have developed a comprehensive approach aiming at the protection of soil functions. In Germany, a soil protection act is in place that aims at the protection and restoration of sustainable soil functions. It obliges all parties to

[31] European Commission,September 2000. Addressing desertification and land degradation. The activities of the European Community in the context of the United Nations Convention to Combat Desertification.

prevent hazards, to avoid soil sealing and to take precautions against harmful soil changes.

In the UK, England is developing an overall soil strategy. The consultation paper considers several types of pressure on soil and lists sustainable responses. It sets out a new set of key soil indicators and targets, and addresses the relation between soil and land-use planning.

In Denmark and Sweden soil protection is considered an integral part of general environmental protection. In Sweden a monitoring programme on ecosystems includes several soil parameters.

In France a national action plan on soil management and protection has been agreed that emphasises on the prevention of future pollution. It contains inter alia a new soil monitoring network based on a 16 km to 16 km grid, the completion of the national soil map and maps on erosion risks and soil organic matter. Austria has developed a soil information system with Internet access.

Other Member States focus on particular threats. In the Netherlands policy concentrates on various types of soil contamination, including groundwater. Regulations on diffuse contamination define acceptable inputs and losses of agricultural nutrients. In Belgium, Flanders has established a legal framework for a liability regime concerning both historically and newly contaminated sites.

Among the Candidate Countries Czech Republic, Slovakia, Poland, Hungary, Slovenia, Romania, Bulgaria, Cyprus and Malta are also signatories to the UN Convention to Combat Desertification (UN-CCD) and are preparing national action programs in this context.

In Slovenia soil protection is part of the National Environmental Action Programme that deals with the cleaning up of degraded soils and the implementation of sustainable use of agricultural land. The programme is prepared on the basis of detailed existing soil data, accessible through the internet.

In Hungary soil protection is driven by the general environmental protection legislation, as well as by specific legislation on the protection of arable land, the protection of soil, land and groundwater and the redemption of contaminated sites.

6. COMMUNITY POLICY RELEVANT FOR SOIL PROTECTION

Although an explicit Community policy focused on soil protection does not exist at this stage, a broad range of Community instruments influence soil protection. Due to the multifunctional role of soil and its universal presence, many policies are involved, and, in addition, state aid is permitted for the rehabilitation of contaminated soils. The effect of these policies on the state of soils has so far not been systematically assessed. Most prominent among these are the Environmental, Agricultural and Regional Policies, but the Transport and Research Policies also affect soil.

6.1. Environmental Policy

The close link between soil and the other major compartments water and air, is reflected in specific environmental legislation, targeted at them, but in turn generally contributing to the protection of soil. The relationship between soil protection and legislation on waste and land use policy is equally obvious.

Community legislation on water (Nitrates Directive[32] and Water Framework Directive[33]) sets standards to prevent the contamination of surface and groundwater by the leakage of hazardous substances or excessive nutrients from soils. The Nitrates Directive places emphasis on the establishment of good farming practice in all areas and on action programmes in nitrate vulnerable zones. It includes provisions to improve soil condition, such as winter cover crops and adjusted soil management in areas with steep slopes. The Water Framework Directive aims to secure the ecological, quantitative and qualitative functions of water. It requires that all impacts on water will have to be analysed and actions will have to be taken within river basin management plans. Wherever contaminated soils, erosion or excessively fertilised soil contribute to surface or groundwater contamination, the necessary remedial action will in many cases lead to improved soil protection.

Contaminants in polluted air most likely to reach the soil directly or with precipitation are heavy metals and materials contributing to acidification and eutrophication. Legislation aiming to reduce and monitor air pollution (Air Quality Framework and Daughter Directives[34] and Directive on National Emissions Ceilings[35]) therefore impacts on soil protection**.** Further developments will be achieved through the forthcoming thematic strategy for air quality CAFE (Clean Air for Europe).

Waste management is one key element to prevent soil contamination. Most directly linked is the Sewage Sludge Directive[36] that regulates the use of sewage sludge in agriculture in such a way as to prevent harmful effects on soil. In more general terms the Waste Framework Directive[37] requires that waste is to be disposed without endangering the soil. Further specific waste legislation such as the Landfill Directive[38], the Incineration Directive[39] and the Urban Wastewater Directive [40]may contribute to the prevention of soil contamination.

Land use policy can play an important role in protecting soil resources, by limiting soil sealing and ensuring that soil characteristics (e.g. soil erosion risk) are taken into account in decisions concerning allocation and use of land. A separate Communication on "Planning and Environment - the territorial dimension" is under preparation and will take a number of soil-related aspects into account. It will address inter alia the sealing of greenfields and the appropriate re-use of brownfields.

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32 Council Directive 91/676
33 Directive 2000/60EC of the European Parliament and of the Council
34 Council Directives 96/92/EC, 1999/30/EC and 2000/69/EC
35 Directive 2001/81/EC of the European Parliament and of the Council
36 Council Directive 86/278/EEC
37 Council Directive 75/442/EEC
38 Council Directive 1999/31/EC
39 Directive 2000/76/EC of the European Parliament and the Council
40 Council Directive 91/271/EEC

It will make the case for rational land use planning that takes the soil's capacities into account.

General environmental legislation also has an impact on soil protection. The Integrated Pollution Prevention and Control Directive[41] requires industry and intensive livestock farms exceeding well-defined sizes to prevent emissions of pollutants to air, water and land, to avoid waste production and dispose of waste in a safe way, and to return disused industrial sites to a satisfactory state. The Strategic Environmental Assessment Directive[42] requires an environmental assessment to be carried out for certain plans and programmes including the area of land use, which should have a beneficial result for soil protection. The Environmental Impact Assessment Directive[43] requires an environmental assessment for certain private and public projects. Inter alia the likely impact on soils has to be examined. Under the chemicals legislation risk assessments and risk reduction strategies are produced for a considerable number of substances. The risk assessments carried out under the Existing Substances Regulation[44], address the risks related to emissions of the substances to the soil compartment. Comparable legislation exists for the assessment of new chemicals[45], of plant protection products[46] and of biocidal products[47]. The Habitats Directive[48] is of particular relevance since it defines a number of terrestrial habitats that depend on specific soil characteristics, such as dunes, peat lands, calcareous grasslands and wet meadows.

The financial instrument LIFE supports innovative solutions for some of the soil threats as well as for sustainable use of soil.

6.2. The Common Agricultural Policy (CAP)

As agricultural production is so dependant on soil and 77 % of land in the EU is used for agriculture and forestry, agricultural policy has by definition a huge impact on soil. The reform of the Common Agricultural Policy in the context of Agenda 2000, building on measures introduced in the 1992 reform, established the importance of rural development policies as the second pillar of the CAP. In 2000 new rural development plans were approved including a definition of Good Farming Practice (GFP), based on verifiable standards where soil protection received considerable attention.

GFP constitutes a core element of the new rural development policy: the granting of compensatory allowances in less favoured areas is conditional on the respect of GFP and agri-environmental measures provide compensation for undertakings going beyond this baseline. Good Farming Practice is defined as the standard of farming which a reasonable farmer would follow in the region concerned. It entails in any case compliance with general mandatory requirements including environmental

41 Council Directive 96/61/EC
42 Directive 2001/42/EC of the European Parliament and of the Council
43 Council Directive 97/11/EC
44 Council Regulation (EEC) No 793/93
45 Commission Directive 93/67/EEC
46 Council Directive 91/414/EC
47 Directive 98/8/EC of the European Parliament and of the Council
48 Council Directive 92/43/EEC

legislation but Member States may establish additional requirements associated with good practice.

Within the rural development plans, some Member States facing erosion risks included practices such as tillage following contour lines, while some with low soil organic matter have banned the burning of cereal stubble. Maximum livestock carrying capacities have been defined by several Member States to avoid soil degradation through overgrazing.

Agri-environmental measures aimed at soil protection range from overall farm management systems such as organic farming (including maximum stocking rates) and integrated crop management (ICM) to specific measures such as no-tillage or conservation practices, grassland strips, winter covers, use of compost and the maintenance of terraces. Measures aiming at a reduced use of pesticides, such as integrated pest management (IPM) or promoting balanced rotations can also contribute to improve the condition of agricultural soils.

Within the market pillar of the CAP, the Agenda 2000 reform introduced new environmental protection requirements, whereby Member States shall take the environmental measures they consider to be appropriate in view of the situation of the agricultural land used or the production concerned and which reflect the potential environmental effect. These measures may include support in return for agri-environmental commitments, general mandatory environmental requirements or specific environmental requirements constituting condition for direct payments. Member States shall decide on penalties for non-respect of environmental requirements, which may include a reduction or the cancellation of the market support.

A number of measures within the individual market regimes offer opportunities for soil protection. These include set-aside in the arable sector, the extensification premium in the beef sector and the possibilities within national envelopes in the dairy, beef and sheep sector.

An increased level of integration of environmental concerns into the CAP is to be envisaged in future: the further shift of resources to rural development foreseen in the Commission Communication on Sustainable Development[49] will provide new opportunities for agricultural techniques protecting soils.

6.3. Regional Policy and Structural Funds

Regional and agricultural structural fund programmes have as a general and compulsory objective to contribute to sustainable development. Measures in these programmes contribute directly or indirectly to the improvement and protection of soil. Examples are erosion and flood prevention, rehabilitation of derelict and polluted land and measures for sustainable tourism and leisure. For all large planned investment measures an environmental impact analysis study is to be performed.

The Community's strategy for Sustainable Development also makes reference to the need to put the European Spatial Development Perspective (ESDP) into action, including the implementation of an observatory network to analyse the regional

[49] COM (2001) 264 (page 6)

impact of Community policies. The European Spatial Planning Observatory Network (ESPON) programme includes several measures relevant to efficient land protection.

6.4. Transport Policy

The range of potential effects of transport on soil is very broad. Most important are the land take by transport infrastructure and fragmentation of ecosystems and habitats through transport networks. Soil quality is affected by water runoff from roads and airport runways, use of persistent herbicides on railroads, emission of NO_x from motor vehicles, disturbance of groundwater flows due to construction work and contamination risks associated with the transport of dangerous goods.

The White Paper on a Common Transport Policy[50] describes the current transport policy. It sets out the need for the integration of transport into sustainable development. It lists packages of measures aimed at shifting the balance between modes of transport, in particular from road and aviation to the more environmentally friendly modes of rail and waterway transport.

The indicator system TERM provides a monitoring system aimed at assessing the environmental performance of the transport sector. It includes indicators for land take and fragmentation.

6.5. Research Policy

In the context of various Community research programmes, a number of soil protection problems are addressed. In the current 5th Research Framework the programmes “Environment and Sustainable Development” and “Quality of Life" are supporting soil-related research.

In the key action “Sustainable management and quality of water” a number of research activities are dedicated to assess and minimise pollution originating from industrial activities, from contaminated land, waste disposal sites and sediments or diffuse pollution originating from land-use practices. The interactions between soil and water are also being studied in the context of integrated water management. Ongoing RTD activities are addressing sustainable, risk-based management of contaminated land and groundwater. The Contaminated Land Rehabilitation Network for Environmental Technologies, CLARINET, is a policy-orientated expert network on the management of contaminated land.

In the Environmental Applications domain of the “Information Society Technologies Programme” several research projects are carried out which are relevant for improved management of soils.

The key action “Global change, climate and biodiversity” studies vulnerable ecosystems, of which soils are principal components, in relation to climate and global change. Particular attention is given to the driving forces in land degradation and desertification in the fragile ecosystems of Europe. Research effort is also put on assessment of impacts of policies and practices.

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50 COM (2001) 370

In the "Quality of Life programme" research is carried out on new farming systems reducing negative impact on environment and soils. Prevention and control of erosion and salinisation form also part of research activities promoting sustainable use of the soil**.** For instance, the PESERA research project will assess soil erosion risk all over Europe.

In addition, the European Soil Bureau, a specific project of the Commission's Joint Research Centre (JRC), is a network of soil science institutions. It is carrying out scientific and technical work programmes in order to collect, harmonise and distribute soil information from countries all over Europe relevant to Community and national policies.

The proposed 6th Research Framework supports soil related research in the priority "Sustainable Development, Global Change and Ecosystems". It will focus on large scale integrated assessment of land/soil degradation and desertification in Europe and related prevention and mitigation strategies. Furthermore, it will address soil aspects in relation to the water cycle. Other priorities aim at a better understanding of terrestrial biodiversity and on the role of soil as a carbon sink. In addition under the priority "Specific activities covering a wider field of research", the 6th framework programme will support research underpinning the formulation and implementation of Community policies (6th Environment Action Programme), including environmental assessment (soil and water, including the effects of chemical substances). The JRC programme will continue to support the European Soil Bureau as a network of soil science institutions providing policy relevant soil information to the Commission services.

7. EXISTING SOIL DATA GATHERING SYSTEMS

7.1. Soil surveys

Soil surveys collect data on the physical and geological properties of soils, in order to define soil types and to draw up soil maps. This information is static based on the assumption that soil and soil properties only change over extremely long periods.

Most of the national soil survey organisations in Europe were established almost 50 years ago in response to the need to ensure food self-sufficiency. Land Capability Classification, principally in relation to agriculture, was developed in the UK, Germany and other countries at that stage.

Soil data sets from different countries were generally established using different nomenclatures and measuring techniques, thereby creating comparability problems. The related soil maps based on the data are also extremely variable in Europe. Differences of national coverage and scale are common and only Belgium and The Netherlands have soil maps at scales of 1:50.000 covering their whole national territory.

In 1985 a first soil map of the European Community countries was finalised under the Commission's initiative. This 1:1.000.000 scale map was based on the soil classification system adopted by FAO/UNESCO and indicated different soil types.

The European Soil Information System (EUSIS), which is the only homogeneous soil information available at EU scale, was developed by the Joint Research Centre

of the European Commission and the National Soil Surveys. It currently extends to the EU, EFTA and the Central and Eastern European countries and in the future will include all Mediterranean basin countries. EUSIS provides soil maps at 1:1.000.000 scale. It also provides a number of interpretative models for more complex information of environmental interest such as soil erosion risk, soil organic carbon content and soil compaction risk.

EUSIS however has limitations. Firstly, the comparability of physical and chemical information is limited since it is based on data collected over a long period by National Soil Surveys using different methodologies. Secondly, it delivers information at a very coarse scale for environmental protection purposes. Furthermore, it lacks integration with other soil databases. However, its most serious constraint is that it delivers static information without any indication on changes and trends.

7.2. Monitoring systems

Based on systematic sampling and analysis, soil monitoring systems aim to deliver information on changing soil parameters, important for soil functions, such as nutrient status, organic matter, biodiversity and heavy metal contamination.

Monitoring systems already operate in Austria, France, Finland, The Netherlands, Sweden and the UK with a periodicity ranging from 5 to 10 years. A recent initiative in France, RMQS (Réseau de Mesures de la Qualité des Sols), based on the monitoring system for forest soils, has established a nation-wide soil quality monitoring network based on a 16 by 16 km grid with 2,000 sampling plots. Every 5 years it will measure a number of environmental parameters such as diffuse pollution and organic matter.

The only monitoring system in Europe covering a number of soil aspects was developed as a part of large-scale scheme monitoring the health of forests in the context of Council Regulation 3528/86 on the Protection of Forests against Atmospheric Pollution. This monitoring system is restricted to forests. It was designed for purposes other than soil protection and only addresses a number of soil parameters, e.g. organic carbon, heavy metals, soil acidity and buffer capacity.

The measurement of these parameters was completed only once in 1992 based on partial harmonisation of sampling and analytical methods. Further work on harmonisation is ongoing.

7.3. Soil data networks

In a wider environmental context, the European Environmental Information and Observation Network (EIONET) was established to assist The European Environment Agency (EEA) in producing policy-relevant information on Europe's environment through the delivery of relevant national data. It is a network of national environmental information networks, of centres of expertise (currently for soil, contaminated sites and land cover) and European Topic Centres (ETCs) as EEA contractors coordinating activities in their thematic areas. There are ETCs for air, water, nature, waste and terrestrial environment.

The European Topic Centre on Terrestrial Environment (ETC/TE) technically supports the EEA in the implementation of the soil monitoring and assessment framework through the maintenance and further development of databases and information for use in indicator development and reporting on soil and land issues. In particular, it carries out assessments of past trends, current state and prospective development of soil quality and degradation. A core set of soil related indicators are being developed in the domains of soil sealing, soil erosion, local and diffuse contamination as main soil issues.

In addition the land use/cover statistical survey LUCAS is a pilot survey developed by Eurostat and carried out throughout Europe during 2001. It aims at the collection of data on land use, land cover and environmental features such as erosion and natural hazards. Information on erosion includes the registration of the number of rills, gullies and accumulation zones. The survey will again be carried out in 2003.

7.4. Soil data comparability

To reach a common understanding throughout Europe of soil degradation processes, it is important to ensure data comparability. To this end, sampling procedures and soil analytical methods have to be harmonised in the future.

Experience has shown that the major bottleneck for the assessment of soil condition in Europe based on already existing data still is the lack of harmonised methodologies for monitoring and data transfer, leading to a lack of comparability of the data.

The elaboration of internationally accepted standards takes place in international standardisation organisations such as CEN (European Committee for Standardisation) and ISO (International Organisation for Standardisation).

8. THE WAY FORWARD: BUILDING BLOCKS OF A THEMATIC STRATEGY ON SOIL

The principle of sustainable development is at the core of Community policy. The achievement of this objective will require policies delivering appropriate levels of soil protection.

To date, despite the delivery of some soil protection through several existing policy areas, a comprehensive Community approach to soil protection does not exist. Soil protection is more the result of the crosscutting nature of soil than the outcome of an explicit intention to tackle soil problems. A thematic strategy is needed to underpin an integrated and targeted effort for a sustainable management of soil in the EU.

Soil protection requires an integrated approach based on existing knowledge and the adjustment and improvement of existing policies. However, it also requires the development of a more long-term approach whereby protection is based on a more complete knowledge both of the direct and indirect impacts of human activities and of the best practices and measures to address soil protection problems. This knowledge also includes awareness of the probable increasing threat due to climate change.

Historically, national, regional and local authorities have dealt with soil issues. Such an approach was justified by the geographical variability of soil, which requires soil policies to have a strong in-built local element.

On the other hand, there is substantial evidence that soil problems have not only a local dimension but also wider and indeed global consequences including for food security, poverty reduction, water protection and biodiversity. Hence concerted approaches are more likely to be effective in providing solutions. Therefore the Community has a role in soil protection policy, where it can deliver added value vis-à-vis action carried out individually by Member States. Moreover Community initiatives should take account of relevant international conventions, most notably the UN-CCD.

The distinctive characteristics of soil for policy development were described earlier in this Communication. Soil protection policy will have to focus on the principles of prevention, precaution and anticipation. It needs to ensure the protection of soil biodiversity and organic matter which are central to soil functions. It should use monitoring as an indispensable tool and take environmental liability into account.

In developing its thematic strategy for soil protection the Commission is aware of both the threats described, the relevant policy features and the need for integration.

8.1. Actions in relation to the threats to soil

Based on the existing knowledge, a number of initiatives to stop and revert soil degradation processes will be taken through individual Community policy instruments. However as degradation processes are closely linked, the combined effect of actions to address particular threats will be beneficial to overall soil protection.

8.1.1. Environmental policy

Environmental policy provides the opportunity to address most threats, and in particular those relating to contamination, soil organic matter, biodiversity and sealing.

Full implementation of existing legislation, including the Nitrates Directive, the Water Framework Directive, the Air Quality Directives, the Landfill Directive, the Habitats Directive and other, more general environmental legislation, will make a significant contribution to the prevention of contamination and the protection of biodiversity. The implementation of the Strategic Environmental Assessment Directive will be relevant to address soil sealing, since it will lay a strong emphasis on soil issues covering all projects supported by the Structural and Cohesion Funds beyond a certain sealed area threshold.

New legislation will be proposed in the following areas.

During 2002 the 4th Daughter Directive under the Air Quality Framework Directive will be proposed relating to heavy metals and PAH.

During 2002 a directive on mining waste will be proposed and by 2004 a document established on the best available techniques for the management of mining waste.

During 2003 the Commission will undertake a revision of the Sewage Sludge Directive entailing a reduction in maximum permitted levels of contaminants in sludge, and possibly its extension to all land where sludge is applied and to other sludges.

By the end of 2004 a directive on compost and other biowaste will be prepared with the aim to control potential contamination and to encourage the use of certified compost.

The fact that Regulation (EEC) No 2158/92 on protection of the Community's forests against fire will expire on 31.12. 2002 will not prevent the Commission from paying special attention to the development of the Community forest-fire information system. This will enable the effectiveness of the protection measures against fires to be better assessed, which will be relevant in the framework of erosion prevention.

To protect soil biodiversity, the Commission could consider the extension of the annexes of the Habitats Directive to complete the so far limited list of soil-based habitats requiring special protection should it be shown that existing designation is insufficient. Complementarily, the importance of soil in the management plans for designated Natura 2000 sites will be increased. A considerable amount of research will be required to establish more completely the biodiversity aspects of soil and the areas which might merit such designation.

In addition to the legislative initiatives, during 2003 the Commission will present a Communication on “Planning and Environment – the territorial dimension”, addressing rational land-use planning and taking into account the need for sustainable management of soil resources. Geographic Information systems (GIS), which should be a major tool in the planning process, will be instrumental in providing the necessary support to an appropriate common policy for sustainable land, and hence soil use. Where erosion, salinisation, floods and landslides are problematic, restrictions in land use will have to be considered. More positively, the communication will also address the need to protect land (and thus soils) of prime agricultural value for long term food production.

The Commission will also develop a strategy on the sustainable use of pesticides (i.e. plant production products and biocides) as outlined in the 6th Environment Action Programme.

In the context of the Climate Change Convention, the Commission is also aware of the desirability to sequester carbon. It will examine ways in which soil organic matter can be increased, in this way responding to the challenge of carbon sequestration, while at the same time delivering at least partial solutions to several of the other threats on soil, in particular erosion and loss of biodiversity. The result of this examination may lead to particular proposals in the context of the main EU policies.

Furthermore, soil will be included within the main themes of the Commission’s public awareness campaigns in the environmental area.

8.1.2. Common agricultural policy

The overwhelming importance of soil for agriculture and forestry has been highlighted. Agriculture and forestry soils are subject to threats originating in other sectors, but in addition some farming practices can result in soil degradation, while others can be beneficial to soil protection.

The Common Agricultural Policy already provides opportunities for soil protection. A number of agri-environmental measures offer opportunities for the build-up of soil organic matter, the enhancement of soil biodiversity, the reduction of erosion, diffuse contamination and soil compaction. These measures include support to organic farming, conservation tillage, the protection and maintenance of terraces, safer pesticide use, integrated crop management, management of low-intensity pasture systems, lowering stock density and the use of certified compost. In line with the integration approach these measures can be developed further to enhance beneficial practices.

The Commission recalls the importance of Article 3 of Regulation 1259/99 in so far as the protection of soil in the context of Good Farming Practice is concerned. It encourages Member States to make use of this provision, in particular where soil degradation problems related to poor farming practices are widespread.

The Commission is committed to expanding the financial commitment to Rural Development in the review of the CAP. The Commission is reflecting on possibilities to strengthen measures in both agriculture and forestry delivering increased soil protection.

More attention will be paid to forestry and afforestation so that they provide long-term environmental benefits including through the prevention of soil erosion. Member States will have in particular the possibility to introduce or reinforce forest fire prevention measures in their Rural Development programming documents from 2003 onwards.

In addition, in line with the proactive approach required for soil protection, the Commission will include soil protection issues in the discussion on the future evolution of good agricultural practices as a policy tool.

8.1.3. Other Community policies

Infrastructural developments and transport tend to pose problems to soil related to sealing, local and diffuse contamination and erosion. Particular support programmes of the Structural Funds have as a crosscutting objective the improvement and protection of soil in order to mitigate this.

As the extent of environmental legislation covering aspects of soil protection increases, the Commission will consider how to integrate it further into Regional and Cohesion planning. It may be necessary in the next programming period to address the issues of sealing and contamination together with other issues relating to soil and land to be addressed in the Communication on Planning and Environment.

In Transport Policy, the problems of soil sealing and diffuse contamination will be addressed.

Since soil and soil functions are both complex and crucial for long-term sustainability, a stronger emphasis of research policy on soil is required. Further study of the impact of human activities on soil functions at the appropriate geographical level will be promoted through the Sixth Research Framework Programme. Particular attention should be paid to a better understanding of the soil ecosystem and how to manage it in a sustainable way. Other research issues are the potential impact of a decline in soil biodiversity, development of effective monitoring schemes for soil threats and the effect of climate change on soil threats.

In the context of the enlargement process, the Community will pay particular attention to soil protection issues by ensuring that potential negative effects on soil from infrastructure works supported by the Instrument for Structural Policies for Pre-accession (ISPA) are avoided.

In Candidate Countries the Special Accession programme for Agriculture and Rural Development (SAPARD)[51] provides certain opportunities for soil protection. Agri-environmental pilot actions in this framework can include actions to combat soil erosion, improve soil quality and soil tillage practices, organic farming or extensive grazing.

At the international level, while continuing to honour its commitments in the UN Conventions, the Community will have to ensure that a soil protection dimension is included in EC development co-operation policy in those regions facing severe soil problems.

8.2. Monitoring soil threats

The actions to be taken in the near future to address soil protection are based on existing information, which is recognised as incomplete. For the long-term protection of soils it will be necessary to ensure the development of a more complete information basis, monitoring and indicators to establish the prevailing soil conditions, and to evaluate the impact of diverse policies and practices.

The specifications of a Community information and monitoring system on soil threats will be the subject of an appropriate proposal for a soil monitoring legislation. It will aim to ensure that a number of measurements on the identified threats in the relevant areas are carried out in a harmonised and coherent way and that its results are relevant to and accessible for policy makers and for early warning purposes. As regards contaminants, the monitoring will give priority to those substances that can be transferred from soil to food or have potential health implications in any other way.

The monitoring system to be established should in so far as possible be based on existing information systems, databases and know-how. The principle of cost-effectiveness will be taken into account. Such system should be designed in such a way that the data can be integrated into more comprehensive/multi-layered monitoring and reporting programmes, for example the Commission's Infrastructure for Spatial Information in Europe initiative. The consultation process should be completed to allow a formal proposal to be made by mid 2004.

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[51] Council Regulation (EC) No 1268/1999

During 2002 the Commission will reflect on the future replacement of Council Regulation 3528/86 on the Protection of Forests against Atmospheric Pollution so that it can contribute more fully to general soil monitoring and in particular to localised problems related to the environment.

Together with a basic monitoring of soil conditions throughout Europe, this legislation would provide the necessary flexibility to focus, where necessary, on more locally relevant threats and degradation processes and their driving forces. Such threats include problems of contamination related to particular industries or transport with a local dimension, but of Community relevance. In this way soil monitoring can be used not just to ensure soil protection itself, but as a measure of the effectiveness of other protection policies and as a tool for their improvement where necessary.

8.3. Future soil protection

The Commission emphasises the need for the establishment of a comprehensive monitoring system to form the knowledge base for coherent actions in the future.

General monitoring will give information on the extent and the evolution of existing widespread threats and will provide the basis for policy development to respond more fully and accurately to them. In this way monitoring can become a driving force for policy adjustment and revision for the benefit of soil protection.

Specific monitoring will focus on local scale threats and their driving forces and lead to action in sectors which are the original source of soil degradation, thus focusing on the elimination particularly of contamination at source. An example could be focused soil monitoring close to industrial plants or highways. At present the soil is the recipient of many contaminating emissions. When some contaminants accumulate in soil, they provide a threat not just to soil functions, but more widely via leakage to water and bio-accumulation to plant, animal and human health.

Over an extended period, priorities particularly for specific monitoring will change as actions are carried out so leading to a programme of work to deliver not just soil protection, but also, where necessary, improved regulation of activities in sectors which may be contributing to soil degradation.

9. THE WORK-PLAN AND TIMETABLE FOR BUILDING THE THEMATIC STRATEGY

A thematic strategy on soil will build on the actions indicated in Chapter 8 which will contribute to an improved protection of soils. To prepare additional measures, the Commission will establish an inter-service group on soils in order to ensure an integrated approach to soil protection across the different policy areas. This group will follow the development of the initiatives enumerated in section 8.1 as well as identifying other opportunities for promoting soil protection. The Commission will publish a report by June 2004 on the technical measures and legislative and policy initiatives which it has taken to promote soil protection.

In order to address the challenging task of developing better instruments for soil protection, the Commission will work together with Member States, Candidate countries, the EEA, academia and other stakeholders. The Commission will provide the leadership and co-ordination but this will be a collective effort with the burden of

work being shared among all participants on the basis of a detailed work-plan. The objective of the work will be to assist the Commission in developing:

- a proposal for soil monitoring;

- a Communication on soil erosion, soil organic matter decline and soil contamination including detailed recommendations for future measures and actions.

The proposal for soil monitoring will be finalised by June 2004. In preparing this proposal, the Commission will be guided by various current initiatives. To this end, work is already underway to identify best approaches to monitoring and this will be both intensified and linked to particular issues including erosion, the decline in organic matter and contamination.

With regard to the Communication:

- A more complete picture of the extent of contamination within the current and future enlarged EU is needed. In order to achieve this, the Commission will rely heavily on the work of Member States, Candidate Countries and of the CLARINET expert network. Best practice in the management and remediation of contaminated sites will be identified and priorities for future remedial action indicated.

- The Commission is fully aware of the significance of soil erosion in the Mediterranean Region in particular, although evidence strongly suggests that erosion is taking place in many regions of the EU. The Commission intends to organise a conference on soil erosion and the related issue of the decline in organic matter during 2003. This conference should bring together all stakeholders both from the EU and candidate countries and also other Mediterranean countries. Several countries are developing or have developed plans in order to fulfil commitments in relation to the UNCCD and this conference should provide an opportunity to describe progress and problems in tackling soil erosion thus contributing to the Commission's reflections for the Communication.

- The conference will also examine the situation in relation to organic matter including measures which could be taken to redress the decline and increase soil organic matter levels.

Building on the actions to be taken until then, the measures to be presented in the Communication together with the proposal for soil monitoring will establish the thematic strategy on soil protection. It is incremental in approach addressing issues now to the extent possible and setting the basis for more solid work to ensure soil protection in the medium term and future. The Communication, in particular, will place emphasis on actions to be taken to address identified problems and so will ensure that soil protection is treated as a major issue to be tackled both within and outside the EU.

10. CONCLUSIONS

In presenting this Communication on soil protection, the Commission is placing soil alongside water and air as environmental media to be protected for the future. Soil is both essential to human existence and subject to human activities.

In developing a soil protection strategy the Commission has taken a pragmatic approach directed in the first instance towards the adjustment of existing policies relevant to soil taking both a preventative approach through the development of new environmental legislation and an integrational approach for sectoral policies of particular relevance for soil. This integrational approach is fully in line with the Cardiff process and sustainable development.

In addition the Commission has established the need to provide a more solid base through monitoring for actions in the future. These actions will be beneficial not only to soil, but will also contribute to reducing water and food contamination by hazardous pollutants and will therefore contribute to the limitation of environmental impact on human health.

Soil protection has both a national and community-wide dimension and requires that Member States implement national and community relevant policy.

The Commission requests the Council and the European Parliament to endorse the approach it has established in this Communication.