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

Thematic Strategy for Soil Protection

IMPACT ASSESSMENT OF THE THEMATIC STRATEGY ON SOIL PROTECTION

{COM(2006)231 final}
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1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Policy background

The 6th Community Environment Action Programme[1] requires the development of a Thematic Strategy on soil protection "addressing the prevention of, *inter alia*, pollution, erosion, desertification, land degradation, land-take and hydrological risks taking into account regional diversity, including specificities of mountain and arid areas"[2].

Consequently and as a first step, the Commission presented its approach to soil protection in a Communication "Towards a Thematic Strategy on soil protection"[3]. The main threats to soil described were erosion, decline in organic matter and biodiversity, contamination, sealing, compaction, salinisation, landslides and flooding[4]. The Commission stressed the importance of integrating soil aspects into other policies, but also indicated the need for legislation focussing exclusively on soil.

This Communication was the subject of favourable conclusions by the other European Institutions which recognised that soil has a major role with respect to long term European sustainability.

The European Parliament stated in particular "the urgent need to regulate its (soil) use and assess and mitigate the impact of external actions", and generally supported the approach of the Commission, including the necessity for Community action and some legislative proposals[5].

The Council welcomed the Communication as it "provides a comprehensive overview of the elements and factors related to soil threats, as well as of existing Community policies relevant for soil protection, and establishes the basis for the identification of the future Community actions for its protection" and underlined that "the proper functioning of the single market may require also a common approach to soil policy, in so far as its protection and remediation at all relevant levels may also affect competitiveness"[6].

The Economic and Social Committee especially emphasised the need for objectives to be set for European soils, the need for an assessment of the threats in the different

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1 Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme (OJ L 242, 10.9.2002).

2 Article 6(2)(c).

3 COM (2002) 179.

4 Flooding has been addressed in a separate Communication on flood risk management prevention, protection and mitigation (COM (2004) 472) and has therefore been excluded from the Thematic Strategy on soil protection.

5 European Parliament resolution on the Commission communication 'Towards a Thematic Strategy for Soil Protection' (COM(2002) 179 - C5-0328/2002 - 2002/2172(COS)) adopted on 19 November 2003.

6 Council conclusions on integrated soil protection adopted on 25 July 2002.

regions, the importance of building any new data collection and monitoring systems on already ongoing activities, and the need to address the issue of private ownership of soil[7].

The Committee of the Regions emphasised the need for a vision on the sustainability of European soils as well as for the establishment of targets and local risk-orientated and cost-effective programmes of protection[8].

1.2. Consultation

In developing the strategy, the Commission has broadly consulted stakeholders and the public:

In February 2003 the Commission organised an open stakeholder meeting to launch a wide public consultation and to call for volunteers to participate in a set of Working Groups that would assist the Commission in the development of soil policy.

In May 2003, on the basis of candidacies received, the Commission established a wide platform of more than 400 members, composed of five Working Groups and an Advisory Forum with a steering role. The members of these groups were experts from public administrations, agricultural, industrial, environmental and consumer organisations, science and research institutes, the European Environment Agency, the Join Research Centre and other Commission services, as well as many other associations which had European coverage and an interest in soil. The Working Groups, on the basis of mandates prepared by the Commission, addressed the following issues:

- Monitoring of soil,
- Erosion,
- Decline of organic matter and biodiversity,
- Contamination,
- Research, sealing and cross-cutting issues.

Throughout the process a continuous information exchange with other stakeholders not participating in the groups was also carried out.

An electronic mailbox for receiving public questions and feedback on soil was created as well as a comprehensive public electronic library and information

[7] Opinion of the Economic and Social Committee on COM(2002) 179 adopted on 18 September 2002.
[8] Opinion of the Committee of the Regions on COM(2002) 179 adopted on 12 February 2003.

repository, called CIRCA[9], to allow stakeholders within and outside the platform to transmit input and follow the progress of the work.

In June 2004, the Working Groups finished their extensive reports which included information on the state of soils in Europe, the pressures, the driving forces for soil degradation and a set of recommendations addressed to the Commission for the development of an EU soil policy. These reports have been published by the OPOCE[10], and are also available without charge on the Internet[11].

In parallel to the external consultation, the Environment Directorate-General of the Commission, by means of an ad-hoc Inter-service Working Group, worked closely with other Directorates-General (such as those for Enterprise, Agriculture and Rural Development, Regional Policy, Development, Transport and Energy) on the development of a soil policy at EU level.

In November 2004, the Dutch Presidency of the Council held a conference gathering Member States and participants to the stakeholder process who expressed strong support for a framework approach based on EU action[12].

In June 2005, the Environment Directorate-General presented an outline of a proposal for a Soil Thematic Strategy to the Member States. A Common Implementation Strategy to accompany the implementation process was seen as very beneficial.

In August/September 2005, for a period of eight weeks, the Commission carried out an Internet consultation aimed at citizens, soil experts and organisations to elicit opinions on specific measures being considered for inclusion in the strategy. This consultation was done by means of two questionnaires (one for citizens and one for experts and organisations) available in seven languages (EN, FR, DE, ES, IT, NL, PL). The minimum standards for consultation were respected during the consultation process and the Commission does not claim that the group of respondent is a statistically representative sample for the EU.

The results of these questionnaires are presented hereafter.

The consultation drew replies from 1,206 citizens, 377 soil experts and 287 organisations from 25 countries.

The majority (91%) of participating European citizens expressed the view that preventing and mitigating soil degradation in Europe is important or very important, favoured (74.6%) that action be taken under the form of a framework adopted at EU level and concrete measures at national or local level (16.4% advocated taking all

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9 http://forum.europa.eu.int/Public/irc/env/soil/library.

10 L. Van-Camp, B. Bujarrabal, A-R. Gentile, R.J.A Jones, L. Montarella, C. Olazábal and S-K. Selvaradjou (2004), Reports of the Technical Working Groups Established under the Thematic Strategy for Soil Protection, EUR 21319 EN/1, OPOCE, Luxembourg.

11 http://forum.europa.eu.int/Public/irc/env/soil/library?l=/reports_working&vm=detailed&sb=Title.

12 http://www.vrom.nl/pagina.html?id=19039.

measures at EU level), supported the identification of risk areas (87.8%) and the obligation to adopt measures in those areas (96.5%) and ranked the possible measures in order of priority. As regards the different measures proposed to deal with soil contamination, the endorsement of the responding citizens (that fully agree or rather agree) ranged between 95.3% and 98.9%.

Most soil experts and organisations which replied also believed that preventing and mitigating soil degradation in Europe is important or very important (90.2%); they clearly preferred (87.8%) that a framework be developed at EU level and measures established at national/local level. For the measures proposed, only few participants (0.9-3%, depending on the threat) flagged that these could have high negative economic or social impacts on their activities. As regards the different measures proposed to deal with soil contamination, the endorsement of soil experts and organisations (that fully agree or rather agree) ranged between 81.3% and 98.8%.

A comprehensive report on the statistical analysis of all questions and how the feedback has been taken into account is published on the internet[13] and attached to this report as Annex 2.

1.3. Expertise

This impact assessment is based mainly but not exclusively on the following information:

- Reports from the Working Groups[14] set up to assist the Commission.

- A study commissioned by the Environment Directorate-General and carried out by Ecologic and BRGM to assess the economic impacts of soil degradation[15].

- A study commissioned by the Environment Directorate-General and carried out by TAUW and LEI on economic, environmental and social impacts of different measures to prevent soil degradation[16].

In addition, support has also been sought/obtained from other sources, such as:

(1) INSEA[17], an ongoing research project funded by the European Commission (under the Scientific support to policies in 6th Framework-programme), which provided a model to quantify the environmental and economic effects

13 http://ec.europa.eu/comm/environment/soil/index.htm.

14 L. Van-Camp, B. Bujarrabal, A-R. Gentile, R.J.A Jones, L. Montarella, C. Olazábal and S-K. Selvaradjou (2004), Reports of the Technical Working Groups Established under the Thematic Strategy for Soil Protection, EUR 21319 EN/1, OPOCE, Luxembourg.

15 Assessing the Economic Impacts of Soil Degradation, Study Contract ENV.B.1/ETU/2003/0024 (hereinafter 'Ecologic study').

16 Service Contract in Support of the Extended Impact Assessment for the Soil Thematic Strategy Proposals, ENV.B.1/SER/2004/0048 (hereinafter 'TAUW study').

17 Project INSEA - Integrated Sink Enhancement Assessment, DG Research - Directorate Environment, Contract 503614.

of measures to be taken in arable farming against erosion and loss of organic matter.

(2) Several EEA reports (references given when they are quoted).

(3) A Report on Soil Resources of Europe[18] has formed the basis for an internal Commission Working Document "Status of soil data in EU 25 – soil maps, soil monitoring, soil data bases" to assess the extent of already existing information on soils in EU 25.

(4) Preliminary results of a study commissioned by the Environment Directorate-General on market based instruments for soil protection, by the Institute for Environmental Studies[19].

(5) A report on common criteria to identify risk areas for erosion, organic matter decline, compaction, salinisation and landslides from the Joint Research Centre in Ispra and the European Soil Bureau Network[20].

2. EXTENT AND COSTS OF SOIL DEGRADATION IN THE EU

The following sections present the soil threats that have been considered in the strategy. Findings are based on a literature review covering 60 studies, and five case studies analysed more in detail.

It should be borne in mind that the effects of degradation on the non-use values attached to soil (e.g. the patrimonial value of preserving soil for future generations) could not be monetised for any of the threats.

The analysis presented in this chapter focuses on the total cost of soil degradation. Nevertheless, it should be borne in mind, that Member States are currently taking some measures under existing national or Community legislation, to either prevent soil degradation or to mitigate its effects. The present assessment could not take into account the contribution of measures already in place for the following reasons:

- there is no sufficient information on where and what specific measures are taken;
- there are no ex-post evaluations of these measures which would allow an assessment of their efficiency to combat soil degradation;
- some measures have been adopted too recently (cross-compliance) or not yet (Water Framework Directive).

Therefore this analysis does not represent the real current baseline.

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18 Jones R.J.A., Houšková, B., Bullock , P. and Montanarella L. (eds), Soil Resources of Europe, Second Edition, European Soil Bureau Research Report (2005), EUR 20559 EN.

19 Service contract n° 070501/2005/414243/FRA/G1.

20 See: http://eusoils.jrc.it/esbn/Esbn_overview.html.

On-site and off-site cost entries which are marked with ** could be quantified and were included in the calculation of the total costs for degradation.

2.1. Erosion

2.1.1. Qualitative analysis

Erosion is a natural process, which can however be significantly accelerated by human activities. It is known to be a serious problem throughout Europe, especially in the Mediterranean zone, but snowmelt erosion happens in Scandinavian countries and wind erosion is common in Central and Western Europe.

Main human-induced driving forces

- Soil disturbance e.g. ploughing up-and-down slopes
- Removal of vegetative soil cover and/or hedgerows
- Increased field size (open fields)
- Abandonment of terraces
- Late sowing of winter cereals
- Overstocking
- Poor crop management
- Inappropriate use of heavy machinery, in agricultural and forestry practices, but also during construction works.

Soil erosion is increasing in Europe[21]. As precise estimates are not possible due to the lack of comparable data, it is difficult to assess the total area of the EU affected by erosion. The EEA estimated 115 million ha, or 12% of Europe's total land area, to be affected by water erosion, and that 42 million ha are affected by wind erosion, of which 2% severely affected[22].

Due to the difficulty to assess the affected area, erosion *risk* has been proposed as an indicator of actual erosion, which can be assessed on the basis of predictive models such as PESERA[23]. This model covers most of the EU25, except Sweden, Finland, Malta and Cyprus, where Corinne Land cover data is not available.

PESERA predicts that overall 3.4% of the area of the 21 Member States covered (1.6 million hectares) is at risk from erosion of more than 10 tonnes per hectare and year, 18% (54 million ha) are at risk of losing soil above 1 tonne per hectare, and 25% of the area (corresponding to 75.5 million hectares) is at risk to lose more than

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21 EEA, Chapter 7: Soil, in: Europe's Environment: the Dobris Assessment, 1995.
22 *Ibidem.*
23 M. J. Kirkby *et al.*, Pan-European Soil Erosion Risk Assessment: The PESERA Map, Version 1, October 2003, European Soil Bureau Research No. 16, EUR 21176, OPOCE, 2004.

0.5 t of soil per hectare and year. The Mediterranean region is the most affected, but there is clear evidence that also other parts of EU25 suffer significant soil erosion. For some weather events, the losses can be much more significant: for instance, in a rainstorm in the South of Spain, 20 tonnes of soil can be washed off just one hectare in a few hours.

It is worth noting that as natural soil formation is extremely slow, losses over 1[24] or 2 [25] tons/ha/year are therefore considered irreversible.

The consequences of erosion for soil fertility and soil ecosystems are significant, as soil is practically a non-renewable resource due to the fact that soil formation is extremely slow.

Consequences of erosion

- Loss of soil
- Loss of soil fertility due to disrupted nutrient cycles
- Damage to infrastructures due to excessive sediment load
- Diffuse pollution of surface water
- Negative effects on aquatic ecosystems and thereby biodiversity
- Restrictions on land use hindering future redevelopment and reducing the area of productive and valuable soil available for other activities (agricultural and forestry production, recreation etc.)
- Land value depreciation
- Reduced water retention capacity, hence higher flood risk
- Human health problems due to dust and particles in the air

The following costs resulting from these impacts have to be considered:

On-site costs (costs basically borne by the owner or the user of the land)

- Yield losses due to eroded fertile land**
- On-site costs due to impact on tourism

Off-site costs (costs borne by third parties and society, such as public administration, private sectors, tax payers and society as a whole)

- Costs of sediment removal, treatment and disposal**
- Costs due to infrastructure (roads, dams and water supply) and property damage caused by sediments run off and flooding**

24 EEA, Europe's Environment: the second assessment, 1998.
25 Soil ATLAS of Europe, European Soil Bureau Network, European Commission, 2005, p. 111.

- Costs due to necessary treatment of water (surface, groundwater)**
- Costs due to damage to recreational functions**
- Economic effects due to erosion-induced income losses
- Costs due to increased sediment load for surface waters (e.g. negative effects on aquatic species, difficulties for navigation)
- Costs of healthcare caused by higher exposure to dust and soil particles in the air

2.1.2. Quantitative analysis

Table 1 provides an overview of the sum of the types of costs that could be quantified (marked with **), derived from a review of exiting literature and test cases in the study of Ecologic. Comprehensive and comparable information on the extent of erosion needed for the quantitative analysis was only available for 13 countries (equivalent to a surface area of about 150 million ha).

***Table 1*: Estimated total annual cost of soil erosion (million € 2003)**

	On-site costs	Off-site costs	Total estimate
Lower bound	40	680	**720**
Intermediate	588	6,676	**7,264**
Upper bound	860	13,139	**13,999**

Note: These estimates are taken from the Ecologic study and relate to the surface affected by erosion in 13 countries and to five land use categories covering a surface area of 150 million ha

In recent years, a number of studies (including some from the FAO) have also tried to assess the costs of erosion, all leading to the same conclusion: off-site costs are much higher than the on-site costs.

Another important remark is that if long term effects (20 years) of soil erosion are taken into account, the estimated on-site costs listed in Table 1, i.e. around €800 million would become €3.25 billion[26].

2.2. Decline of soil organic matter (SOM)

2.2.1. Qualitative analysis

SOM, the organic fraction of soil (not including undecayed plant and animal residues), plays a very important role not only for soil fertility, but also for soil structure, buffering and water retention capacity and is crucial for soil biodiversity

[26] TAUW study.

(see section 2.10). Therefore, in this Impact Assessment only the stable fraction of soil organic matter, the fraction that can be transformed into humus, is referred to. Humus means soil organic matter, exclusive of the partial decomposition products of undecayed plant and animal residues, and the soil biomass; its structure is amorphous, specific weight is low and surface area high. The principal constituents are derivatives of lignins, proteins and cellulose combined with inorganic soil constituents. Humus possesses colloidal characteristics which give it the ability to improve soil properties such as structure and porosity, sorption capacity (water, plant nutrients), protection against erosion, buffering capacity and protection of plants from drastic changes in pH, and store for micro-organisms.

SOM plays a major role in the carbon cycle of the soil. Indeed, soil is at the same time an *emitter* of greenhouse gases and also a major *store* of carbon. The global soil carbon pool contains 1,500 gigatons (Gt) of soil organic and inorganic carbon. Furthermore, carbon sequestration in agricultural soils achieved by some land management practices has a potential to contribute to climate change mitigation. Some sources estimate this to be around 2 Gt of carbon annually[27]. As a part of the Climate Change Programme, the potential of soils for carbon sequestration was estimated to be equivalent to 1.5-1.7% of the EU's anthropogenic CO_2 emissions during the first commitment period of the Kyoto protocol.

At the same time, climate change will likely increase the risk of threats due to more extreme weather events such as floods and heavy rainfall as well as increased temperature. This has severe consequences for soil biodiversity as well as for suitability and possibility to produce certain crops.

Main human-induced driving forces

- Conversion of grassland to arable land
- Drainage of wetlands
- Poor crop rotation and plant residue management such as burning crops residues
- Accelerated mineralization due to management practices such as continued tillage
- Deforestation

Around 45% of soils in Europe have a low or very low organic matter content (meaning 0-2% organic carbon) and 45% have a medium content (meaning 2-6% organic carbon)[28]. Besides climatic reasons, unsustainable practices of human activities are the most relevant driving forces.

27 Lal, R., Soil conversion and restoration to sequester carbon and mitigate the greenhouse effect. III International Congress European Society for Soil Conservation, Valencia, 2000.

28 Estimated organic carbon level in the topsoil derived from the European Soil Database.

Scientists concerned due to results indicating increased losses of CO_2 from soil

An article in NATURE (Vol. 437) of 8 September 2005, reports that the carbon content of soil in England and Wales fell steadily in the period 1978-2003, with some 13 million tonnes of carbon released from British soil each year. On average, British soils have lost 15% of their carbon.

Though it is not clear where all the missing carbon has gone, much of it may be entering the atmosphere in the form of greenhouse gases like carbon dioxide and methane, thus exacerbating global warming and speeding up climate change.

They finally conclude that the findings show that losses of soil carbon in the UK, and by inference in other temperate regions, are likely to have been offsetting absorption by terrestrial sinks, greatly adding to the uncertainty of future trends.

Comprehensive and comparable data for EU25 on SOM content is not available, but models exist to estimate it. Such estimations reveal that the problem of soils with very low and low SOM exists in particular in the Southern countries, where 74% of the soil has less than 3.4% organic matter, but also in parts of France, the United Kingdom, Germany and Sweden.

Consequences of decline of SOM for soil fertility and soil ecosystems are significant.

Consequences of SOM decline

- Release of greenhouse gases
- Negative effects on biodiversity, including soil biodiversity
- Reduced water infiltration due to changes in soil structure, hence higher flood risk
- Reduced absorption of pollutants and increased water and air pollution
- Increased erosion with the effects stated above such as:
    - Loss of fertile soil
    - Loss of soil fertility (i.a. due to disrupted nutrient cycles)
    - Damage to infrastructures due to excessive sediment load
    - Diffuse pollution of surface water
    - Negative effects on aquatic ecosystems and thereby biodiversity
    - Restrictions on land use and hindering future redevelopment and reducing the area of productive and valuable soil available for other activities (agricultural and forestry production, recreation etc.)

As a decline in SOM increases erosion, all costs listed in the respective chapter are equally relevant here, but will not be repeated. The following list is limited to the costs directly resulting from a decline of SOM. The following costs have then to be considered for a decline of SOM:

On-site costs (costs basically borne by the owner or the user of the land)

- Yield losses due to reduced soil fertility**

Off-site costs (costs borne by third parties and society, such as public administration, private sectors, tax payers and society as a whole)

- Costs related to an increased release of greenhouse gases from soil**

- Costs due to loss of biodiversity and biological activity in soil (affecting fertility, nutrient cycles and genetic resources)

2.2.2. *Quantitative analysis*

As stated earlier, any assessment of SOM loss on a European level is severely limited by the lack of data and of a clear categorisation for different types of organic matter. While some data exists on the organic matter *content* of soils, there is no consistent Europe-wide data on the organic matter *losses*. Indeed, the impact of organic matter loss on the productivity of soils is much less researched than in the case of erosion.

Annual on-site costs (mainly due to lower soil productivity) of SOM decline have been estimated to be around €2 billion[29].

For the off-site effects of SOM loss, there is evidence that the climate change impact of carbon released from soils is substantial. It has been estimated the annual costs for society derived from the carbon released annually from soils due to the decline of SOM to be between €1.4 and 3.6 billion[30]. From other sources, a result on the same range could be found at least to be € 3.1 billion[31] annually.

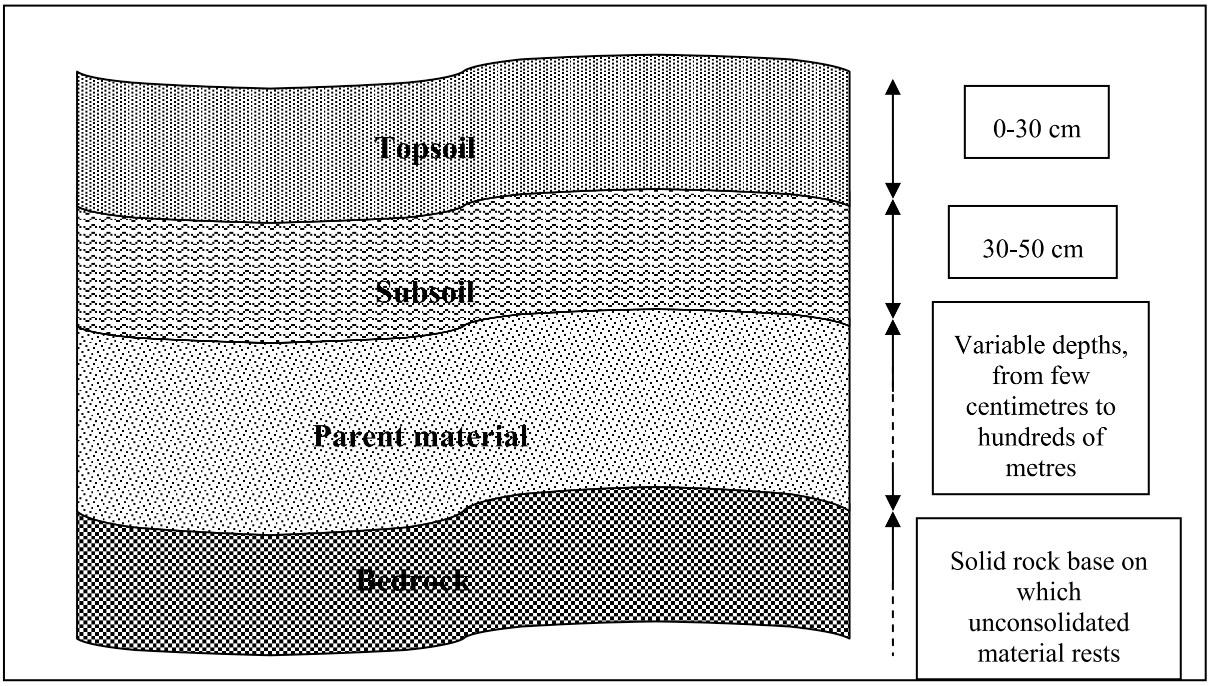
The total annual costs of non action for SOM decline have thus been estimated to be between €3.4-5.6 billion.

2.3. Compaction

2.3.1. Qualitative analysis

Compaction, an increase in bulk density and a decrease in soil porosity, is a problem mainly of the subsoil (see Figure 1).

***Figure 1*: Illustrative soil profile**[32]



29 TAUW study.
30 Ecologic study.
31 TAUW study.
32 Soil profiles can differ quite radically in their appearance, depending on their position in the landscape. The figure presented here is for illustrative purposes only. The vertical dimensions are not in scale. For

Estimates of areas at risk of soil compaction vary. While they all demonstrate the importance of soil compaction, enough data was not available on the actual occurrence of compaction, but data was available on the susceptibility of soils to compaction. Some authors classify around 36% of European subsoils as having high or very high susceptibility to compaction[33]. Other sources speak of 32% of soils being highly vulnerable and 18% moderately affected[34], and again other sources estimate 33 million hectares being affected in total, meaning 4% of the European land[35].

Main human induced driving forces

- Inappropriate use of heavy machinery and increased use of high axle loads due to increased machine power and intensified production
- High livestock densities, in particular in wet conditions or on wet soils
- Large constructions works and recreational sites

The problem is likely to have increased, due to a rise in the use of high-axle loads, which are a consequence of larger machine power and intensified production[36].

more information, please refer to the Soil Atlas of Europe, European Soil Bureau Network, European Commission, 2005, pp. 10-11.

33 Jones, R.J.A., Hiederer, R., Rusco, E., Loveland, P.J. & Montanarella, L. (2003). Topsoil organic carbon in Europe. Proceedings of the 4th European Congress on Regional Geoscientific Cartography and Information Systems, 17-20 June 2003, Bologna, Emilia Romagna, Direzione Generale Ambiente e Difesa del Suolo e della Costa, Servizio Geologoco, Sismico e dei Suoliet al (2003); Van-Camp, L., Bujarrabal, B., Gentile, A-R., Jones, R.J.A., Montanarella L., Olazábal, C. and Selvaradjou, S-K. (2004). Reports of the Technical Working Groups Established under the Thematic Strategy for Soil Protection, p. 179.

34 Crescimanno, G., Lane, M., Owens, P., Rydel, B., Jacobsen, O., Düwel, O., Böken, H., Berényi-Üveges, Castillo, V., Imeson, A. (2004). Final Report, Working Group on Soil Erosion, Task Group 5: Links with organic matter and contamination working group and secondary soil threats. Brussels: European Commission, Directorate-General Environment.

35 Van Ouwerkerk, C. and Soane, B. D. (eds) (1995) Soil compaction and the environment. Special issue, Soil and Tilllage Research 35, 1-113.

36 Crescimanno, G., Lane, M., Owens, P., Rydel, B., Jacobsen, O., Düwel, O., Böken, H., Berényi-Üveges, Castillo, V., Imeson, A. (2004). Final Report, Working Group on Soil Erosion, Task Group 5: Links with organic matter and contamination working group and secondary soil threats. Brussels: European Commission, Directorate-General Environment.

Consequences of compaction

- Loss of soil fertility due to changes in soil structure, i.a. due to reduced oxygen and water supply to plant roots
- Reduced water infiltration and retention resulting in increased water run-off
- Higher erosion susceptibility
- Increased emission of greenhouse gases from the soil due to changes in nutrient cycle
- Loss of soil biodiversity
- Land value depreciation

The following costs have to be considered for soil compaction:

On-site costs (costs basically borne by the owner or the user of the land)

- Yield losses due to reduced soil fertility and increased vulnerability of crops to diseases as a consequence of worsened growing conditions

Off-site costs (costs borne by third parties and society, such as public administration, private sectors, tax payers and society as a whole)

- Costs due to reduced water infiltration into the soil
- Costs due to increased leaching of soil nitrogen
- Costs linked to increased emissions of greenhouse gases due to poor aeration of soil

2.3.2. *Quantitative analysis*

No quantitative estimates of the total costs could be produced. Indeed, economic information on the impacts of compaction is very limited.

As regards on site costs, it has been estimated that surface soil compaction may cause yield reductions of up to 13%, whereas subsoil compaction, as a rough indication[37], may reduce agricultural yields by 35% or more in extreme dry or wet periods.

[37] Van-Camp, L., Bujarrabal, B., Gentile, A-R., Jones, R.J.A., Montanarella L., Olazábal, C. and Selvaradjou, S-K. (2004). Reports of the Technical Working Groups Established under the Thematic Strategy for Soil Protection. EUR 21319 EN/1- Working Group on Research.

On the other hand the off-site costs of compaction could not be estimated at this stage.

2.4. Salinisation

Salinisation, the accumulation in soils of soluble salts mainly of sodium, magnesium, and calcium, can occur naturally in low, poorly drained areas in hot and dry climates, where surface water collects and evaporates, but can be exacerbated by human activities, in particular due to inadequate irrigation of agricultural land.

Main human-induced driving forces for salinisation

- Poor irrigation technology
- Inappropriate drainage
- Use of saline waters for irrigation and the overexploitation of groundwater

2.4.1. Qualitative analysis

Salinisation affects around 3.8 million ha in Europe[38]. Most affected are Campania in Italy, the Ebro Valley in Spain, and the Great Alföld in Hungary, but also areas in Greece, Portugal, France, Slovakia and Austria[39].

The consequences of salinisation for current and future land use are significant.

Consequences of salinisation

- Loss of soil fertility due to toxic effects of high salt content
- Reduced water infiltration and retention resulting in increased water run-off
- Damage to transport infrastructure from shallow saline groundwater
- Damage to water supply infrastructure
- Loss of biodiversity
- Land value depreciation

The following costs have to be considered:

38 EEA, Chapter 7: Soil, in: Europe's Environment: the Dobris Assessment, 1995.
39 Katakouzinos, 1968.

On-site costs (costs basically borne by the owner or the user of the land)

- Yield losses due to reduce soil fertility**

Off-site costs (costs borne by third parties and society, such as public administration, private sectors, tax payers and society as a whole)

- Costs due to damage to transport infrastructure (roads and bridges) from shallow saline groundwater**
- Costs due to damage to water supply infrastructure**
- Environmental costs, including impacts on native vegetation, riparian ecosystems and wetlands**
- Costs due to negative effects on tourism

2.4.2. *Quantitative analysis*

Data on the economic impact of salinisation is limited. The assessment of the total costs of salinisation had to be based on the three countries for which some information exists: Spain, Hungary and Bulgaria. Table 2 shows the yearly costs which have been obtained based on the following assumptions.

For the on-site costs, the extrapolation mainly considers the impacts due to reduced agricultural productivity.

For the off-site costs in the absence of European estimates, impacts were estimated for these three countries taking into account an Australian study, which estimated off-site costs to be approximately €10/ha.

***Table 2*: Yearly cost of salinisation in selected countries (million €)**
(LB: lower bound; UB: upper bound)

		Spain		**Hungary**		**Bulgaria**	
		LB	UB	LB	UB	LB	UB
On-site costs	Agricultural yield losses	42.71	137.64	70.16	133.91	1.08	5.38
Off-site costs	Infrastructure damage	12.08		18.23		1.32	
	Environmental damage	4.83		7.29		0.53	
Total		**59.62**	**154.55**	**95.68**	**159.43**	**2.93**	**7.23**

The total costs, regarding salinisation for these three countries have been estimated to be between €158 and 321 million per year[40].

Extrapolation at EU level was not considered possible. In absence of more detailed information at the appropriate geographical scale, any up scaling of data would be misleading.

2.5. Landslides

2.5.1. Qualitative analysis

Landslides are natural phenomena, which can be exacerbated by human activity or, on the contrary, by lack of human activity. Landslides often occur more frequently in areas with highly erodible soils, clayey sub-soil, steep slopes, intense and abundant precipitation and land abandonment such as the Alpine and the Mediterranean regions.

Main human-induced driving forces for landslides

- Rupture of topography such as due to construction works
- Land use changes such as deforestation and land abandonment
- Extractions of materials

There is no sufficient data on the total affected area in the EU. 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, i.e. 34 million inhabitants. More than 15% of the territory and 26% of the population are subjected to a very high risk[41],[42] and eight major landslides have been document by the International Disaster Database. The threat of landslides is increasing due to population growth, summer and winter tourism, intensive land use and climate change.

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40 Ecologic study.

41 Down to earth: soil degradation and sustainable development in Europe – A challenge for the 21st century, Environmental issue report no 16, European Environment Agency, 2000.

42 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.

Consequences of landslides

- Loss of human lives and well-being
- Damage to property and infrastructure
- Indirect negative effects on economic activities due to interruption of f.i. transport routes
- Loss of fertile soil
- Contamination of soil due to damage to infrastructure such as pipelines and storage facilities
- Potential contamination of surface waters with associated off-site costs as described already under erosion

The following costs have to be considered:

On-site costs (costs basically borne by the owner or the user of the land)

- The loss of topsoil, leading to a loss of productive soil and hence a decrease in crop yield
- Damage to on-site infrastructures

Off-site costs (costs borne by third parties and society, such as public administration, private sectors, tax payers and society as a whole)

- Impact on human lives and well-being
- Damage to property and infrastructure
- Indirect negative effects on economic activities due to interruption of f.i. transport routes
- Ruptures of underground pipelines, dislocation of storage tanks, release of chemicals stored at ground level and contamination of surface waters with associated off-site costs as described already under erosion

2.5.2. *Quantitative analysis*

The International Disaster Database of the Université Catholique de Louvain contains twelve cases of major landslides for EU25, two thirds of which are from Italy. Table 3 below presents the quantified evidence on the incidence and costs of landslides that could be inferred from that database.

Table 3: Incidences and costs of landslides in Europe

	No. of events	Casualties (total)	(av/event)	Affected people (total)	(av/event)	Cost € (total)	(av/event)
Austria	2	43	22	-	-	-	-
Italy	8	1,387	173	10,100	1,263	1,200,000,000	600,000,000*
Sweden	1	13	13	50	50	11,000,000	11,000,000
UK	1	140	140	-	-	-	-
Sum	**12**	**1,583**	**132**	**10,150**	**846**	**1,211,000,000**	**403,666,667****

Source: EM-DAT: The OFDA/CRED International Disaster Database www.em-dat.net – Université Catholique de Louvain, Brussels, Belgium.
* Average based on two out of eight cases, for which there is quantified economic data.
** The average figure (average per event) is based on the three cases of landslides where quantitative data on economic impacts was available (Valtelina/Italy, July 1987, €500 M damage; Ancona/Italy, December 1982, €700 M damage; Gothenburg/Sweden, December 1977, €11 M damage).

The extrapolation of the costs of landslides is not possible in the same way as for other soil threats, which occur continuously and are more widely-spread. Table 3 demonstrates however the wide range of costs for landslides to be between €11 to 600 million per event[43]. Italy is the country for which more data is available. According to the Italian Civil Protection Department, landslides cost between €1 to 2 billion per year to the Italian economy and have resulted in 5,939 deaths during the last century[44]. In a single Italian region (Emilia Romagna), up to 3,300 km of roads and railways are subject to active landslides[45].

There is evidence that the off-site social costs constitute the biggest share of the total damage.

With the available data, no extrapolation to EU level was considered possible.

2.6. Contamination

2.6.1. Qualitative analysis

More than two hundred years of industrialisation have left their trace on the status of soil. Europe has a problem of historical contamination of soil due to the use and presence of dangerous substances in many production processes. Moreover, soil contamination is still currently being produced by inadequate practices and accidents.

43 Note that this is based on information on economic impacts for three events only (see footnote of the Table).
44 http://www.protezionecivile.it/minisite/index.php?dir_pk=251&cms_pk=1444&n_page=2.
45 http://www.regione.emilia-romagna.it/geologia/fran3.htm#dterrit.

Main human induced driving forces

- Industrial installations
- Mining installations
- Illegal waste dumps and landfill sites not properly managed
- Storage of chemicals
- Accidental and provoked spills of chemicals
- Atmospheric depositions of dangerous substances
- Military sites
- Intentional introduction of dangerous substances in the soil

Soil contamination is a widely spread problem across all Europe. Most experts acknowledge that the data available are insufficient for assessing certain parameters, such as the total surface area contaminated per class of contaminant, the percentage of population exposed to the contamination, the environmental damage caused by contaminated sites, etc. This is partly because the data collected by each Member State are not comparable.

Available information indicates that the extent of contaminated sites across Europe is enormous and there is a very unequal progress among Member States in addressing the issue, some being very advanced in the identification of the extent and localisation of the problem, some others only at very preliminary phases.

The effects of soil contamination are very diverse and far reaching in their consequences. Once contaminated, soil functions may be impaired and human and ecological health and food quality may also be prejudiced. The consequences can be suffered where the contamination occurs but are mostly suffered also in a large surrounding area, including agricultural land, dwellings and/or nature reserves[46].

[46] EEA, Chapter 7: Soil, in: Europe's Environment: the Dobris Assessment, 1995.

Consequences of soil contamination

- Risk to human health for people living on and in the surroundings of a contaminated site (through different exposure paths, e.g. consumption of food grown in from contaminated areas)
- Contamination of surface water, mainly through run off of contaminated sediments
- Contamination of groundwater and hence drinking water if extracted from groundwater
- Risk to human health through drinking water extracted underneath of a contaminated site
- Risk of ecotoxicity for the flora and fauna living in the soil on the site and around a contaminated site causing loss of biodiversity and biological activity
- Loss of soil fertility due to disrupted nutrient cycles
- Restrictions on land use and hindering future redevelopment and reducing the area of productive and valuable soil available for other activities (agricultural and forestry production, recreation etc.)
- Land value depreciation

The costs of contamination depend on the type of contaminant, the spatial extent of the pollution and its intensity, the natural characteristics of the contaminated site and the socio-economic characteristics of the surrounding area. However, while such factors have been addressed in local case studies, the calculation of a Europe-wide figure on contamination is impeded by the fact that much of the data is either unavailable or not comparable.

The different cost categories were estimated as follows:

On-site costs (costs borne by the owner or the user of the land)

- Costs of monitoring measures and impact assessment studies that must be carried out in order to assess the extent of contamination and the risk of further contamination of other environmental media (water, air) **
- Costs of exposure protection measures for workers operating on a contaminated industrial site
- Costs due to land property depreciation if land use restrictions are applied thus representing a loss of economic value of the industrial asset

Off-site costs (costs borne by third parties and society, such as public administration, private sectors, tax payers and society as a whole)

These costs are highly site-specific but generally consist of:

- Costs of increased health care needs for people affected by contamination, which include the treatment of patients and the monitoring of their health during long periods to detect the effects of exposure to soil contamination**

- Costs of treatment of surface water, groundwater or drinking water contaminated through the soil**

- Costs for insurance companies

- Costs of dredging and disposing of contaminated sediments down stream borne by water supply companies or public administrations

- Costs for the depreciation of surrounding land**

- Costs for increased food safety controls borne by public administrations to detect contaminated food

Table 4 gives an overview on total costs of soil contamination, derived from the study of Ecologic.

2.6.2. Quantitative analysis

***Table 4*: Estimated total annual cost caused by soil contamination for EU25 (€ M, 2003)**

	On-site costs	**Off-site costs**	**Total**
Lower bound estimate	96	2,283	**2,379**
Intermediate estimate	192	17,126	**17,318**
Upper bound estimate	289	207,615	**207,904**

Estimates for on-site costs are based on a comparison of information from different sources and data available for the case of the MetalEurop site in France. The off-site costs estimates are largely based on available information for the MetalEurop site in France. This is due to the lack of quantified data on off-site costs as regards in particular healthcare costs of neighbouring populations.

These estimates, and in particular the big difference between the lower and the upper bound, show how difficult it is to quantify the costs due to soil contamination and show the disparity between test cases. In order to use a prudent estimate and to the inaccuracy of data, it was considered to be more sound to use the intermediate value of €17.3 billion per year all through out the report.

2.7. Sealing

2.7.1. Qualitative analysis

On average the sealed area, the area of the soil surface covered with an impermeable material, is around 9% of the total area in Member States[47]. In many European countries the built-up area increased by 25 to 75% in the period 1950-1980. During 1990-2000 the sealed area in EU15 increased by 6%[48], and the demand for both new construction due to increased urban sprawl and better transport infrastructures continues to rise[49].

Main human driving forces for sealing

- Urban sprawl
- Increased transport
- Movement of population

Soil sealing through urbanisation dominates in the more densely populated regions and major industrial areas of Western Europe, in particular Belgium, Denmark and the Netherlands, where 16-20% of the surface is built up. Sealing results in the creation of a horizontal barrier between the soil, air and the water and thus has several severe consequences.

Consequences of sealing

- Disruption of gas, water and energy fluxes
- Increased flood risks
- Reduced groundwater recharge
- Increases water pollution (due to runoff water from housing and traffic areas being normally unfiltered and potentially contaminated with harmful chemicals)
- Loss in soil and terrestrial biodiversity (due to fragmentation of habitats)

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47 EEA, Soil degradation in: Environment in the European Union at the turn of the century, Environmental assessment report No 2, 1999.

48 Corine Land Cover.

49 Ecologic study.

The following costs have to be considered:

On-site costs (costs basically borne by the owner or the user of the land)

- Opportunity costs due to restrictions on land use

Off-site costs (costs borne by third parties and society, such as public administration, private sectors, tax payers and society as a whole)

- Cost linked to runoff water from housing and traffic areas, which is normally unfiltered and potentially contaminated with harmful chemicals
- Costs due to fragmentation of habitats and disruption of migration corridors for wildlife
- Costs due to impacts on landscape and amenity values
- Costs on biodiversity

Insufficient data relative to soil-sealing costs is available to provide an assessment of the impacts of soil sealing in economic terms.

2.7.2. Quantitative analysis

There was no sufficient information to estimate the costs derived from sealing of soil. Thus no quantitative assessment could be done.

2.8. Biodiversity

2.8.1. Qualitative analysis

Soil biodiversity means not only the diversity of genes, species, ecosystems and functions, but also the metabolic capacity of the ecosystem[50].

Insufficient data exist on the status of soil biodiversity in Europe, as the biological quality of soil cannot easily be predicted. Although research on soil biodiversity has been carried out in European countries, it is still impossible to reliably quantify the richness, range and different roles played by microbial species.

Soil biodiversity is affected by all the threats listed above, and therefore all driving forces mentioned apply (equally) to the loss of soil biodiversity, changes in land use (agricultural and forestry practices) and soil contamination being the most prominent.

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50 Van-Camp, L., Bujarrabal, B., Gentile, A-R., Jones, R.J.A., Montanarella L., Olazábal, C. and Selvaradjou, S-K. (2004). Reports of the Technical Working Groups Established under the Thematic Strategy for Soil Protection, Vol. III, Organic matter.

Consequences of biodiversity decline

- Reduced food web functioning and consequently crop yield losses
- Reduced soil formation
- Reduced nutrient cycling and nitrogen fixation
- Reduced carbon sequestration
- Reduced resilience of the soil to endure pressures
- Reduced recycling of organic waste/litter
- Increased plant pests and diseases
- Reduced water infiltration rate and water holding capacity
- Reduced bioremediation capacity
- Hampered soil structure (by affecting the stabilisation of organo-mineral complexes)
- Reduced genetic resources present in the soil, including moral and ethical consequences
- Negative impacts on terrestrial biodiversity outside of soil

SOM and soil biodiversity decline are closely related and the costs listed above for SOM decline (see section 2.1.4) equally arise for the loss of soil biodiversity. The following additional costs would need to be considered:

On-site costs (costs basically borne by the owner or the user of the land)

- Yield losses due to reduce soil fertility

Off-site costs (costs borne by third parties and society, such as public administration, private sectors, tax payers and society as a whole)

- Costs linked to the loss of ecosystem functions and reduced capacity to sequester carbon (see also section 4.1.4 under organic matter decline)
- Costs related to impacts on landscape and amenity values
- Costs related to changes in genetic resources

2.8.2. *Quantitative analysis*

There was no sufficient information to estimate the costs derived from sealing of soil. Thus no quantitative assessment could be done. Furthermore, the loss of soil biodiversity is not fully understood from a natural science perspective. Therefore, no quantification of these impacts and costs can be given in this report.

2.9. Conclusions

Though difficult to estimate, several studies demonstrate significant annual costs of soil degradation in the ranges of:

- erosion: €0.7 – 14.0 billion[51],
- organic matter decline: €3.4 – 5.6 billion,
- compaction: no estimate possible,
- salinisation: €158 – 321 million[52],
- landslides: up to €1.2 billion per event,
- contamination: €2.4 – 17.3 billion[53],
- sealing: no estimate possible,
- biodiversity decline: no estimate possible.

No assessments of costs to society of compaction, soil sealing and biodiversity decline are currently available. The total costs of degradation that could be assessed for erosion, organic matter decline, salinisation, landslides and contamination, on the basis of available data, would be up to €38 billion[54] annually for EU25. These estimates are necessarily wide ranging due to the lack of sufficient empirical quantitative and qualitative data.

It must be highlighted that these costs of soil degradation do not take into account the effect of standards adopted in January 2005 under cross-compliance nor the effect of other measures recently taken by Member States. For erosion and organic matter decline, they have been produced by estimating the costs of the degradation per hectare and multiplying by the most recent estimate of the number of hectares at risk of suffering these threats. The available estimates of the extent of the hectares at risk might not take into account possible improvements yielded by recent measures. Nevertheless, as changes in soil are very slow, it is likely that the current estimate of the extent of the problem is an appropriate reference.

Evidence shows that the majority of the costs are borne by society in the form of damage to infrastructures due to sediment run off, increased health-care needs for people affected by contamination, treatment of water contaminated through the soil,

51 This estimate covers only costs of erosion in 13 countries, including the major Member States where erosion occurs. Data is not available for the others.

52 This estimate covers only the costs of salinisation in three countries, data is not available for others.

53 An independent study estimated that the costs of soil contamination could amount annually to up to €208 billion. Nevertheless this estimate had a high degree of uncertainty, therefore the intermediate value of €17.3 billion per year was retained.

54 For this estimate the intermediate bound was taken for contamination, while the upper bound was taken for the other threats, see section 2.1.7.

disposal of sediments, depreciation of land surrounding contaminated sites, increased food safety controls, and also costs related to the ecosystem functions of soil. Although many of these costs could not be monetised, they can be assumed to be very high. Therefore, the real costs for soil degradation are likely to exceed the estimates given above.

3. EXISTING POLICY FRAMEWORK FOR THE PROTECTION OF SOIL

3.1. Member States level

Specific legislation on soil as an environmental media exists only in few Member States (f.i. the Netherlands, Germany, some Austrian regions).

Most Member States have included some soil protection aspects in general environmental or agriculture legislation, thereby addressing the issue in a fragmented way and not comprehensively addressing all threats to soil as identified in the Communication COM(2002) 179.

Specific legislation on soil contamination exists in less than a dozen Member States, though other countries have some soil contamination provisions embedded in other legislation concerning, for instance, waste or pollution prevention. It appears that obligations and legislative acts differ significantly in approach and level of detail.

Different action plans have been established, such as in England (soil strategy), France (action plan on soil management), and Slovenia (National Environmental Action Programme).

Some Southern (Greece, Italy, Portugal and Spain) and some Eastern Member States, being affected areas, have adopted or are in the process of adopting Regional Action Programmes and National Action Programmes under the United Nation Convention to Combat Desertification (UNCCD).

3.2. Conventions and protocols

The 1972 Council of Europe's Soil Charter, revised in 2003, called on States to promote a soil conservation policy, and 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. As a result of the Earth Summit in Rio de Janeiro in 1992 and the Johannesburg World Summit on Sustainable Development, several conventions with consequences for soil protection were launched.

The 1992 UN Framework Convention on Climate Change (UNFCCC) 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, e.g. soils.

Soil biodiversity issues are addressed by the 1992 Convention on Biological Diversity (CBD), aiming to conserve biological diversity, encouraging the sustainable use of its components, and sharing 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.

The 1994 UN Convention to Combat Desertification (UNCCD) aims to prevent and reduce land degradation, rehabilitate partly degraded land and reclaim desertified land through effective actions supported by international co-operation and agreements.

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, bringing together EU, EFTA and Accession Countries as well as the Commission and the EEA. Its role was to provide a better understanding of soil protection issues and to promote the exchange of information. It aimed to bring the discussion on soil protection from the scientific and technical level to the administrative and policy area thus contributing to the elaboration of the Commission's Communication COM(2002) 179.

The 2001 Stockholm Convention on persistent organic pollutants (POPs), requires that the Parties endeavour to develop appropriate strategies for identifying sites contaminated by POPs.

Under the Alpine Convention aiming at protecting the Alpine region, the Protocol on Soil Protection seeks to preserve the ecological functions of soil, prevent soil degradation and ensure a rational use of soil in that region. It includes a series of principles and measures pertaining in particular to contamination, erosion and soil sealing.

3.3. EU level

Soil has not, to date, been subject to a specific protection policy at EU level. However, several Community policies, such as on environment, agriculture and rural development, transport, regional development contain provisions or objectives related and contributing to soil protection.

3.3.1. Links to objectives from other environmental legislation

Community **water** legislation aims to secure good quantitative, qualitative and ecological quality of all water (Water Framework Directive[55]), to avoid contamination of waters with nitrates from agricultural sources (Nitrates Directive[56]), to ensure ground water quality[57] and to prevent floods[58]. This is done

55 Directive 2000/60/EC.
56 Directive 91/676/EC.
57 COM (2003) 550.
58 COM (2004) 472.

by, for instance reducing direct and indirect inputs of pollutants, including sources on or in the soil, and measures to prevent floods. Eroded, contaminated, sealed or excessively fertilised soil contributes to surface or groundwater quality deterioration and flooding. Hence preventive and remedial actions to combat soil degradation will lead to improved water quality and less flood events.

Less soil contamination as a result of the remediation of contaminated sites and actions against diffuse pollution will contribute to the objectives of the Community **air** legislation aiming to maintain ambient-air quality where it is good and improve it in other cases. On the other hand, reduced air emissions imply less atmospheric deposition of dangerous substances into the soil, hence less soil contamination.

Soil protection objectives are present in the **Waste** Framework Directive[59], which requires that waste is to be disposed of without endangering, *inter alia*, the soil, and other specific waste legislation[60]. For example, the Sewage Sludge Directive[61] regulates the use of sewage sludge in agriculture in such a way as to prevent harmful effects on soil. The recently adopted Directive on the management of waste from extractive industries[62] requires the drawing up of inventories of closed waste facilities, six years from the entry into force of the Directive. The general soil protection objective of the Waste Framework Directive can be coupled with the objective to promote the recycling of waste in the context of the **Thematic Strategy on prevention and recycling of waste**[63].

In **chemicals** legislation, in particular under the Directives on Authorisation of Plant Protection Products[64] and on Biocidal products[65], the work on the upcoming proposal for a **Thematic Strategy on the sustainable use of pesticides**[66] as well as the REACH proposal[67] recognise the importance of soil protection.

Biodiversity will generally benefit from all actions proposed for the different threats. Improved soil biodiversity will contribute to achieve the objectives to halt the decline of biodiversity by 2010 as laid down in the Communities Sustainable Development Strategy[68], the need to integrate biodiversity into soil policy[69] and support the Habitats Directive[70], aiming directly at preserving i.a. a number of terrestrial habitats that depend on specific soil characteristics, such as dunes, peat lands, calcareous grasslands and wet meadows.

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59 Directive 75/442/EEC.
60 Directive 1999/31/EC, Directive 2000/76/EC, Directive 91/271/EEC and Decision 2003/33/EC.
61 Directive 86/278/EEC.
62 Directive 2006/21/EC.
63 COM(2005) 666.
64 Directive 91/414/EEC.
65 Directive 98/8/EC.
66 COM(2002) 349.
67 COM(2003) 644.
68 COM(2001) 264.
69 Malahide declaration, see: http://biodiversity-chm.eea.eu.int/stories/STORY1087980667/.
70 Directive 92/43/EEC.

The expansion of cities into the surrounding rural areas, known as **urban** sprawl, is an important concern of the Community policy on the urban environment and relates to the **Thematic Strategy on the urban environment**[71]. Activities aiming at limiting urban sprawl and ensuring the rational use of the land will contribute to reduce soil sealing.

Natural resources include both the raw materials necessary for most human activities often extracted from soil, and the different environmental media, such as air, water and soil, which sustain life. Careful management of the use of these resources is a basis for sustainable development as described in the **Thematic Strategy on the sustainable use of natural resources**[72].

3.3.2. Links to other Community policies

In the 2003 **Common Agriculture Policy** reform[73] obligatory provisions were introduced for farmers receiving direct payments to respect specific statutory management requirements and maintain land in Good Agricultural and Environmental Condition (cross compliance). Member States are required to define such (GAEC) at national or regional level, including for soil erosion, soil organic matter and soil structure through the establishment of standards. These standards concern minimum soil cover, minimum land management reflecting site specific conditions, the retention of terraces, standards for crop rotations where applicable, arable stubble management and appropriate machinery use. Furthermore, Member States are required to define a minimum level of land management with regard to livestocking rates and/or appropriate regimes, the protection of permanent pasture and the retention of landscape features.

These cross compliance standards should ensure a minimum level of soil protection for agricultural land receiving direct payments under the first pillar of CAP with respect to erosion, organic matter and compaction. However, in non-agricultural land, in agricultural areas where a higher risk of soil degradation occurs or where agricultural activities take place which are not subject to direct payments or certain rural development payments, additional measures provided for under this strategy will be necessary to reach its objectives. As regards rural development, some Member States have used, in the current programming period, i.a. the agri-environmental measures to combat various soil threats. They will have this possibility again in the next programming period (2007-2013). In addition, the baseline for most of the measures of Axis 2 of the new Rural Development Regulation will be cross-compliance at the minimum.

Structural fund programmes have as a general and compulsory objective to contribute to sustainable development, and many measures in these programmes contribute directly or indirectly to the protection of soil. Examples are erosion and flood prevention, rehabilitation of derelict and polluted land and measures for

[71] COM(2005) 718.
[72] COM(2005) 670.
[73] Regulation (EC) No 1782/2003.

sustainable tourism and leisure. Identification of risks areas for the different soil threats, an inventory for contaminated sites and mechanisms to finance the remediation of "orphan sites" will be valuable to make funding more efficient.

3.4. Soil legislation of important trading partners

Several important trading partners of the EU, such as Australia, Brazil, Canada and the United States, have addressed soil protection in different, although quite substantial ways:

- Soil erosion and desertification have also been recognised as important issues in Brazil, where i.a. public authorities are obliged to fight against soil erosion and to assure and monitor rational use of soils. A map with areas at risk of desertification has also been developed. In the United States, a Soil Conservation Act was agreed already in 1935, and the Soil Conservation Service, predecessor to the Natural Resources Conservation Service, began working already in 1933 with farmers to prevent erosion.

- Salinisation has been identified as one of the most significant environmental problems in Australia, where it has been addressed via a National Action Plan endorsed in 2002. Its objective is to prevent, stabilise and reverse trends in dryland salinity and to improve water quality.

- Regarding contamination, Australia has drafted guidelines on prevention, management and remediation at national level, while management of contaminated sites is carried out at regional level. In Brazil, regulations have been developed, addressing i.a. the remediation of contaminated sites and emphasising the polluter pays principle. In the United States, the Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as Superfund, created in 1980, provides i.a. for liability of persons responsible for releases of hazardous waste and established a tax on the chemical and petroleum industries. The money is used for cleaning up abandoned or uncontrolled hazardous waste sites. Canada addresses soil contamination by its Environmental Protection Act.

In addition to the legislation listed above, many non-EU countries are also parties to the international conventions and protocols mentioned in this impact assessment and are consequently implementing the different obligations therein.

3.5. Current use of market based instruments

The Commission investigated the current use of market based instruments (MBIs) to protect soils in the EU and elsewhere[74]. Indeed in some environmental areas, MBIs have shown to be a valuable alternative to regulation and have a large potential for cost-effective environmental improvement. The results show that, at present, the use of these instruments is largely confined to erosion and contamination with the

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[74] Service contract n° 070501/2005/414243/FRA/G1.

dominant instrument-type being subsidies. Examples of other MBIs, such as taxes, charges and tradable permits, are few and there is very limited information on the cost-effectiveness of the instruments. With the present data and knowledge gaps, the Commission considers that the introduction of such instruments at the European level is not appropriate at this stage. However, the Commission encourages the Member States to make use of such instruments in the implementation of the strategy.

3.6. Conclusions

Different Community policies contribute to soil protection, particularly environment (e.g. air and water) and agricultural (agri-environment and cross-compliance) policy. For instance, land management practices such as organic and integrated farming or extensive agricultural practices in mountain areas can maintain and enhance organic matter in the soil and prevent landslides respectively.

Achieving the objectives of the Water Framework Directive will entail changes in practices in soil management and the protection of some soils, but only where soil degradation hinders water quality. It addresses soil as far as it is a pressure to water but does not provide a protective regime for soil in all circumstances, does not cover all threats to soil thus does not ensure a sustainable use of soil as an essentially non renewable resource in Europe.

Though significant benefits can be expected from linking the direct payments to farmers to the application of some soil-friendly agricultural practices, these measures are not obligatory everywhere, they are just a precondition to receive payments for the farmers who are under the payment regimes (not all markets are under these regimes). Some farmers do not receive payments hence are not bound to adopt these soil-friendly practices. Cross-compliance will only contribute to the soil preservation in a partial way.

These provisions in favour of soil protection are spread across many areas and, to the extent that they often aim to safeguard other environmental media, do not constitute a coherent soil protection policy. This means that even if exploited to the full, existing policies are far from covering all soils and all soil threats identified.

There are different approaches to soil protection in the Member States and the level of progress in soil protection varies enormously between the Member States. Some being fairly advanced, some being at early stages.

The major conclusion therefore is that given that soil degradation continues (and even accelerates at some point) the existing policy framework does not guarantee the high level of protection to soil and the environment that the European Union has committed itself to achieve; it is simply not enough.

4. OBJECTIVES OF THE STRATEGY

Soil performs many functions and services vital to human activities and ecosystems survival. Indeed, soil provides us with food, biomass and raw materials. It serves as a platform for human activities, landscape and heritage, while it has also a role as a habitat and gene pool. It performs the storage, filtration and transformation of energy and many substances including water, nutrients and carbon, and constitutes the major carbon store in the world.

4.1. The general objectives

The variety of functions, the difficulty to define soil quality standards due to the variability and complexity of soils, the specific features of soils and the range of degradation processes to which they are subject, require a comprehensive approach to soil protection based on the general objective of preservation of soil functions rather than soil quality standards. Consequently, the guiding principles for the protection of soil within this common objective are:

(1) Preventing further soil degradation and preserving its functions:

- when soil is used and its functions are exploited, action has to be taken on soil use and management patterns, and
- when soil acts as a sink/receptor of the effects of human activities or environmental phenomena, action has to be taken at source.

(2) Restoring degraded soils to a level of functionality consistent at least with current and intended use, thus also considering the cost implications of the restoration of soil.

4.2. Specific objectives

Most of the soil threats represent risks in specific areas. These are linked to natural conditions (climate, topography, soil type etc.) and to human activities. Identification of different risk areas and contaminated sites within the EU territory will therefore be necessary as a first step, followed by the setting of risk reduction targets and adoption of measures to achieve such targets and the overall general objectives.

For soil sealing, a risk approach is not suitable, as sealing is intentionally caused and normally subject to planning decisions.

4.3. Link to other policies and previously established objectives

As described in section 2.3, different policies can contribute to the protection of soils. Reciprocally, as soil interacts with all other media, the achievement of the objectives to protect and restore its functions will undoubtedly allow achieving objectives set out in other Community policies and international agreements, for instance as regards water quality, nature protection or climate change mitigation.

As recognised by the Commission in the Thematic Strategy on the sustainable use of natural resources[75], the sustainable use of resources is hence a key ingredient of long-term prosperity, both within the EU and globally. Indeed, the EU Strategy for Growth and Jobs[76] endorsed by the Spring Summit of 2005 (revised Lisbon strategy) gives high priority to more sustainable use of natural resources. The Thematic Strategy on soil protection is a contribution to that challenge. Moreover, the recently reviewed Sustainable Development Strategy (SDS)[77] has set the objective of safeguarding the earth's capacity to support life in all its diversity and respect the limits of the planet's natural resources. As soil is an essentially non-renewable resource of common vital interest throughout the EU, the Thematic Strategy on soil protection will contribute to reaching that objective.

5. NEED FOR EU ACTION

As mentioned in chapter 1, the 6th Community Environment Action Programme requires the development of a Thematic Strategy on soil protection "addressing the prevention of, *inter alia*, pollution, erosion, desertification, land degradation, land-take and hydrological risks taking into account regional diversity, including specificities of mountain and arid areas".

The Institutions have broadly welcomed the analysis and proposals for solution contained in the 2002 Communication launching the debate on soil protection at EU level. In particular, the Council:

- underlined the need for appropriate Community action to protect soil and provide for its sustainable use. It should take already existing Community policies and measures and subsidiarity appropriately into account;

- considered that the proper functioning of the single market may require also a common approach to soil policy, insofar as its protection and remediation at all relevant levels may also affect competitiveness.

- requested the Commission to bring forward the Thematic Strategy for Soil Protection, based on an integrated approach and with a comprehensive and long-term perspective with a view to maintain the vital functions of the soil, which should include where appropriate relevant qualitative and quantitative targets and timetables, general principles for assessing and managing the threats, as well as identify actions for its implementation, including appropriate sustainable use and soil protection measures. It should also consider the possible long distance degradation effects of some human actions including inappropriate soil management, in particular through water and air pollution.

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75 COM(2005) 670. Natural resources include also soil.
76 COM(2005) 141.
77 COM(2001) 264 and COM(2005) 658.

While the request of the Institutions to the Commission to address soil protection at EU level needs to be acknowledged, at the same time the Commission believes that important reasons call for an intervention at EU level, such as:

- **Soil degradation affects other environmental areas** for which Community legislation exists. Failure to protect soil will undermine sustainability and long-term competitiveness in Europe. Indeed, soil is interlinked with air and water in such a way that it regulates their quality. In addition soil functions enormously contribute to areas such as biodiversity and marine protection, coastal management, and to the mitigation of climate change.

- **Distortion of the functioning of the internal market** – the wide differences between national soil protection regimes, in particular as regards soil contamination, sometimes impose very different obligations on economic operators, thus creating an unbalanced situation in their fixed costs. The absence of such regimes and the uncertainty as regards the extent of soil degradation can, in some cases, also hinder private investment. The Directive on environmental liability[78] creates a harmonised framework for the liability regime to be applied across Europe when land contamination creates a significant risk to human health. However, it does not apply to historical contamination or damage prior to its entry into force.

- **Impacts in other areas** – soil degradation has negative impacts on other areas also considered of common interest, such as quality of air and water, biodiversity and climate change.

- **Transboundary impacts** – soil, though generally immobile, is not completely so and therefore degradation in one Member State or region can have transboundary consequences. Losses of soil organic matter in one Member State impair achievement of the EU's Kyoto Protocol targets. Dams are blocked and infrastructure is damaged downstream by sediments from massive erosion further upstream in another country. Groundwater in bordering countries is polluted by contaminated sites on the other side of the border. Therefore it is of outmost importance to act at source to prevent damage and subsequent remedial actions, otherwise costs to restore environmental quality may be borne by another Member State.

- **Food safety** – uptake of contaminants in the soil by food and feed crops and some food producing animals can have an impact on the safety of products which are traded freely within the internal market by increasing their level of dangerous substances and, hence posing a risk to human or animal health. Acting at source and at European level, by preventing soil contamination or reducing its level, will complement the safety controls performed to ensure feed and food safety. Indeed food safety legislation imposes some maximum contents for a limited number of

[78] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (OJ L 143, 30.4.2004, p. 56).

contaminants, and these limit values are established taking into account not only the daily tolerable intake but also the environmental background concentration, in order to realistically ensure food supply. Moreover, food and feed controls are carried out on a limited number of samples chosen at random, hence there is no obligation to check all the food and feed put on the market.

- **International dimension** – soil degradation is receiving increasing attention in international agreements and charters. By establishing an appropriate and coherent framework which will translate into better knowledge and management of soil, the EU can play a leading role internationally, facilitating the transfer of know-how and technical assistance whilst at the same time ensuring the competitiveness of their economies.

- **The Community *acquis* has not hitherto sufficiently ensured soil protection –** although different Community policies can be expected to contribute to soil protection (see section 2.3.3), provisions concerned are fragmented and do not represent a coherent soil protection policy. Hence, soil degradation continues.

In addition, action at EU level will also have an added value by contributing to the protection of the health of European citizens that can be impaired in different ways by soil degradation, for instance because of exposure to soil contaminants by direct ingestion (children in playgrounds) or indirect intake (through contaminated food or drinking water). Equally, casualties may occur in the event of landslides.

The Commission believes that, for all these reasons, there is a need for actions at EU level in order to ensure that the requirement of Art. 174 of the EC Treaty are met, because the objectives of the strategy cannot be sufficiently achieved by the Member States and can therefore be better achieved by the EU.

6. POLICY OPTIONS TO REACH THE OBJECTIVES OF THE STRATEGY

6.1. Possible options

In order to assess which policy option is most appropriate to address the threats to European soils and therefore reach the strategy's objectives, the following options, from less to more prescriptive, have been considered:

(1) Member States are encouraged to take action under a general non-binding EU soil strategy.

(2) A strategy containing a flexible Soil Framework Directive, setting common principles and objectives at Community level, leaving the identification of the areas and sites at risk, definition of targets and design of appropriate measures to Member States and regions. This should be complemented by fostering an improved knowledge base, in particular on soil biodiversity, and better awareness of soil issues as well as greater coordination between the various EU and national policies which impact on the soil (improved integration).

(3) EU legislation for the different soil threats, setting also all targets and means at EU level. Monitoring, soil threats linked to land management (erosion, decline in organic matter and biodiversity, salinisation, compaction and landslides) and soil contamination being addressed in separate legal initiatives.

6.2. Which options have been rejected at an early stage?

Based on the analysis carried out in the previous sections, in particular chapters 2 and 3, and taking into consideration the views received during the stakeholder process, including a public consultation open to citizens, experts and organisations, the Commission is persuaded that options 1 and 3 are not appropriate for achieving the strategy's objective for the following reasons:

Option 1: *Member States are encouraged to take action under a general non-binding EU soil strategy*

The option considered was that of non-binding action at EU level, where Member States would be encouraged to take action under a general non-mandatory EU soil strategy. Achieving soil protection requires actions to protect soil on supranational, national, regional and indeed local levels in order to succeed. However, the fragmented approach taken so far and the extent of the problem with the attached significant off-site and transboundary effects and costs to be borne by society demonstrate that the absence of a focused policy approach has not been sufficient in establishing comprehensive mechanisms to address the identified threats. This calls for a comprehensive approach to soil protection.

Option 3: *The creation of EU legislation for the different soil threats, setting all objectives, targets and means at EU level*

This option has been rejected for the following reasons:

- Soil is very variable regarding its general characteristics, but also with regard to its use in the socio-economic context. This makes is very difficult to establish general EU-wide soil quality standards and measures to address soil threats.

- Historically, some national, regional and local authorities have dealt with soil, generating significant knowledge on where and how to address soil protection in their particular areas. It seems therefore appropriate that full use is made of this experience.

- Detailed and harmonised data and information at Community level on soil degradation is limited.

6.3. Which policy option has been considered?

Having examined the different options, the Commission proposes a Framework Directive as the best means of ensuring a comprehensive approach to soil protection whilst fully respecting subsidiarity. Member States will be required to take specific measures to address soil threats, but the Directive will leave to them ample freedom on how to implement this requirement. This means that risk acceptability, the level of ambition regarding the targets to be achieved and the choice of measures to reach those targets are left to Member States.

This option comprises a flexible Soil Framework Directive, setting common principles and objectives at Community level, complemented by fostering an improved knowledge base and better awareness of soil issues as well as greater coordination between the various EU and national policies which impact on the soil (improved integration). The impacts of this option have therefore been thoroughly analysed in this impact assessment.

6.4. Description of the option chosen

The different proposed actions within a Soil Framework Directive are:

Risk identification: For erosion, organic matter, salinisation, compaction and landslides, the extent of the areas at risk and the degree of risk for each of these threats need to be identified. This can best be done by the Member States themselves. Nevertheless, in order to ensure a coherent and comparable approach, the identification of risk must be carried out on the basis of common criteria. These criteria include parameters which are known to be driving forces for the different threats. Thus each threat is linked to its own set of criteria for the risk identification. Models can also be used to support risk identification. Member States will be able to build upon existing national inventories and monitoring schemes or Community programs such as CORINE Land Cover, LUCAS or BIOSOIL, but additional activities may be necessary to achieve a representative picture of state, impacts and pressures on soil in order to identify the risk areas. Risk identification implies the establishment of unacceptable levels of occurrence of the threats and acceptable risks may be very different between regions having different soil and climatic conditions.

For contamination, a definition of contaminated sites and a list of potentially soil polluting activities will be established at Community level. These would be the basis for Member States to locate sites which can *potentially* be contaminated, as a preliminary step to the establishment of an inventory of *effectively* contaminated sites, constituting the registry of all sites in the national territory for which an investigation has determined there exists a risk for human health or for the environment. This would be complemented by the obligation for landowners or prospective buyers to provide a soil status report for any transaction of land where a potentially contaminating activity has taken or is taking place.

Measures to reduce the risk: Having established the risk areas for erosion, organic matter decline, compaction, salinisation and landslides, Member States would then need to adopt risk reduction targets and programmes of measures to reach those targets. Such programmes may require measures of a compulsory or voluntary nature and cover different sectors such as the construction industry, forestry and agriculture, as appropriate. Programmes can build on standards and measures already identified and implemented in national and Community contexts, such as cross compliance, the codes of Good Farming Practice and Action Programmes under the Nitrate Directive, the future measures under the river basin management plans of the Water Framework Directive and international standards, such as the Pan-European Indicators for Sustainable Forest Management[79]. These programmes may include measures co-financed by the Community, and will strengthen and possibly encompass the efforts currently done by Member States to comply with the obligations under the UN Convention to Combat Desertification.

For local contamination, Member States will have to establish National Remediation Strategies aiming at reducing soil contamination and the risk caused by it. These plans will be based on the inventory of contaminated sites, and on a sound and transparent prioritisation of the sites to be remediated, including timeframes, targets and allocation of resources.

Soil sealing: With regard to soil sealing, a risk approach is not appropriate. Instead, a national or regional approach is proposed, requiring Member States to take the appropriate measures to limit sealing or to mitigate its effects.

Precautionary measures: Soil is, in contrast to air and water, mainly privately owned in the European Union, nevertheless it is a natural resource that has to be protected for future generations to ensure that it is used in a sustainable manner.

Diffuse contamination: In order to make full use of the prevention principle, Member States will be required to take measures to limit the introduction of dangerous substances into the soil, in order to avoid accumulation in soil that would hamper soil functions and create a risk to human health and the environment.

The Commission also proposes the following non-legislative actions, which will not be included into the Soil Framework Directive but will be part of the strategy:

Biodiversity: Measures adopted by Member States to combat the various soil threats will equally contribute to protect and restore soil biodiversity. In addition to this, the Commission proposes to address the existing knowledge gap on soil biodiversity, with a view to take targeted actions if appropriate at a later stage.

Research and awareness raising: There is a need to increase the general knowledge basis and the awareness from the general public, administrations, civil society and economic operators on the importance of soil and soil functions. Mechanisms to improve such knowledge are i.a. research activities, exchange of information and best practices. The Commission therefore proposes that initiatives should be fostered at EU and national level to improve the general knowledge on soil.

Integration: As soil is in many cases the recipient/receptor of the environmental impacts of measures taken in other sectors, the Commission and Member States

79 http://www.mcpfe.org/publications/pdf/improved_indicators.pdf.

should continue to "act at source" and do their outmost to integrate soil protection aspects into other policy areas.

7. QUALITATIVE AND QUANTITATIVE ANALYSIS OF IMPACTS OF OBLIGATIONS SPECIFIED IN THE SOIL FRAMEWORK DIRECTIVE

7.1. Introduction

In the proposed Directive, there are a series of specified obligations aimed at a shared objective which is the identification of the location and extent of the problem of soil degradation and the obligation to act upon it. These obligations are:

- Identification of risk areas for erosion, SOM decline, salinisation, compaction and landslides
- Adoption of a programme of measures for these areas
- Development of an inventory of contaminated sites
- Adoption of a National Remediation Strategy.
- Establishment of a Soil Status report
- Development of a mechanism for funding the remediation of 'orphan sites'.
- Increasing Awareness raising
- Giving priority to the rehabilitation of brownfield sites and the use of soil saving construction techniques

In this chapter, the impacts of these obligations are assessed qualitatively and, when possible, quantitatively.

However, the proposed Directive will finally require Member States to take specific measures to address soil threats, but it leaves to Member States the freedom to implement this requirement. This means that risk acceptability, the level of ambition regarding the targets to be set and the choice of measures to meet these targets are left to Member States. Therefore the impacts of the proposed Directive cannot be assessed to the full extent. Measures taken by Member will be more or less radical depending on their level of ambition and the severity of the soil degradation process. *Qualitatively*, the environmental, economical or social impacts of possible measures may be similar. On the other hand, *quantitatively*, the impacts of possible measures vary enormously depending on the approach and measure taken. Therefore it is not possible within the scope of this impact Assessment to assess all the particular impacts of such specific measures. Hence, in chapter 8 only a general *qualitative* impact assessment of possible measures to combat soil degradation has been provided.

Nevertheless, in order to support and facilitate decision making, the Commission has made an effort by means of different scenarios analysis to attempt to quantify the environmental, economic and social impacts of possible measures. These scenarios are constructed on the basis of expert guess and limited available information from Member States instruments currently in place to address soil degradation. Annex 1 includes this quantification of impacts of the scenarios.

These scenario-generated figures are under no circumstances to be looked at as the real implementation costs of the Soil Framework Directive. They are only presented as an Annex to this Impact Assessment for illustrative purposes.

7.2. Establishment of risk areas and programmes of measures for erosion, SOM decline, salinisation, compaction and landslides[80]

7.2.1. Costs of options considered for risk area identification

On the basis of accurate soil data, policy makers are able to establish adequately the risk areas.

Three main options were considered:

(1) For the risk area identification, use solely the current monitoring schemes Member States have already undertaken.

(2) Fully harmonise risk identification in Member States through a 16x16 km grid for the purpose of both general soil state monitoring using general soil parameters and monitoring of the various soil threats using so called stratified soil parameters. This option is to be regarded as the most ambitious scenario.

(3) Use a monitoring approach targeted to the identification of risk areas.

The costs of options 2 and 3 have been compared to the option 1.

Option 1: Current status of risk area identification in Member States

The current soil monitoring activities are considered to be the no-action scenario for this impact assessment[81]. At the moment some countries (33%) already monitor several of the soil parameters considered necessary in this option (as recommended

80 Due to the lack of estimates on risk areas for landslides at EU level, the impact of possible measures could not been assessed. Nevertheless, measures to prevent landslides can be considered to be somehow similar to that of serious erosion, hence the result is likely to be similar as for erosion in high risk areas.

81 Those soil monitoring programmes that will be carried out in the near future, regardless of this Strategy, are taken into account for the no-action scenario as well.

by the Working Group Monitoring[82]), whereas other countries (10%) hardly measure any data at all.

A brief overview of existing soil information in EU25

Soil surveys are well established in all countries in Europe. They have traditionally been developed to support agricultural development and the planning and organisation of crop production as well as for environmental purposes. They include plot level samplings and the production of soil maps at various scales.

Currently, a harmonised soil mapping approach in the scale 1:250,000 is proposed by the European Soil Bureau Network (ESBN). Such mapping is already underway in several European countries on a voluntary basis and at their own cost. The classification system has been agreed to follow WRB[83], and the scale has been clearly defined as well. Therefore, the resulting maps are expected (a) to show strongly reduced border effects, (b) to allow the definition of a harmonised soil map legend, and (c) to gather better harmonized attribute data.

The investigations of the Working Group Monitoring and the EEA show that a large number of plots have been designated to fit monitoring requirements. However, the sampling and analytical schemes differ quite substantially, which restrict their value for Europe-wide assessments.

The need for soil information, e.g. in agriculture, environmental and research policy, is strongly increasing. The demands can only be fulfilled if soil inventory data, and mapping and monitoring data, are readily gathered into soil information systems. This has been recognized by many countries. However, current resources still concentrate on making existing data usable on a digital basis. Until now, the development of a soil information system (maps, plot inventory data including monitoring) is still the exception.

The availability of national evaluations with regard to occurrence and impacts of soil threats varies greatly within EU25. Member States generally have evaluations regarding only a limited amount of soil threats, some even not having any evaluation at all. However, a more intensive evaluation of the existing soil inventory data is still needed to fully explore the information available and that can best be done by Member States.

Costs

This option does not incur in additional costs.

Option 2: Fully harmonising risk identification in Member States through a 16x16 km grid

82 Van-Camp, L., Bujarrabal, B., Gentile, A-R., Jones, R.J.A., Montanarella L., Olazábal, C. and Selvaradjou, S-K. (2004). Reports of the Technical Working Groups Established under the Thematic Strategy for Soil Protection. EUR 21319 EN/1.

83 World Reference Base for Soil Resources (WRB): accepted international soil classification for Europe.

Option 2 considers a fully harmonised system of monitoring in a 16x16 km[84] grid for inventory data (parameters on general information on soil to be monitored at all grid points) and for stratified parameters (parameters related to the threats to be monitored in points in risk areas only).

Monitoring should be repeated periodically to keep data updated. It has been assumed, based on their variability over time, that the inventory parameters are measured once every 50 years and that the stratified parameters are measured every 10 years.

Costs

The costs per Member State are calculated based on costs for fieldwork, average prices for analyses and tests, and the number of sites. Complex erosion measurements in the field are not considered, since they are performed rarely (use is made of modelling instead), the results vary enormously and they are very expensive and thus would give a distort view on the costs.

The additional costs for this option are the result of the total costs for soil monitoring under such grid minus the expenditure already incurred by Member States for monitoring.

The additional costs of installing a 16x16 km monitoring grid are about €97 million higher than the current expenditures. For a 50 year period for EU25, that represents €2 million annually.

As regards administrative costs linked to the risk area identification (e.g. additional personnel developing or refining the models and carrying out the risk area identification), the Commission has made several attempts to estimate them, but inquiries amongst experts from Member States have not resulted in gathering sufficient data to do so.

Option 3: Monitoring targeted to the identification of risk areas

Option 3 implies that Member States identify risk areas under common criteria by using as much as possible the data they have already gathered or which they would gather in any case in a no-action scenario. However, in case this is not sufficient to meet the criteria, Member States would have to collect the remaining necessary information.

Costs

From the overview on existing soil information presented above, it was concluded that most of the current soil information cannot be used in an aggregated way in order to establish risk areas. Compared to option 1, additional costs may therefore

84 Statistical analysis has shown that a 16x16 km grid sufficiently represents all possible soil type/land use combinations in Europe.

still be needed to complete/develop an operational soil information system equipped with the necessary methodologies and targeted at the specific aims.

Compared to option 2 (harmonised monitoring in a grid system), an estimate of the savings by using as much as possible already existing soil information is not possible at this stage. A more intensive evaluation of the existing soil inventory data with a view to use them for the risk area identification is still needed and can best be done by Member States or regions themselves. However, the costs for option 3 are likely to be significantly lower than the costs identified for option 2, less than €2 million per year for EU25.

7.2.2. *The option chosen*

From the overview on existing soil information it can be concluded that although Member States are already monitoring soil for a series of reasons, there is little relation between existing monitoring schemes and identified soil threats. Thus, the existing monitoring schemes are considered unfit to support the objectives of the strategy. Therefore, option 1 was rejected as a policy option. However, information on existing monitoring schemes has been used to define as efficiently as possible options 2 and 3 and to monetise their additional costs.

While the additional costs for full harmonisation (option2) of around €2 million per year for EU25 are not very substantial, such a harmonised monitoring approach would have administrative impacts, as Member States would need to modify their current monitoring systems and might not be able to use already acquired data. Indeed, such a harmonised system would involve the loss of continuity with existing monitoring systems which are very valuable tools to be used in soil protection policy development. The benefits of such a fully harmonised system for the risk identification were not sufficiently clear to justify this approach. Therefore, option 2 was abandoned.

The option chosen therefore is option 3: *Monitoring targeted to the identification of risk areas.* The additional costs for this option are less than €2 million per year for EU25.

7.2.3. *Benefits of identifying risk areas*

From a targeted soil monitoring scheme, resulting in risk areas, generally two main benefits would arise:

- It would allow targeting the measures to combat the soil threats where they are needed, hence making an efficient use of resources.

- It would allow controlling the effectiveness of these measures to preserve and improve soil functions.

Expenditures on measures provide more value for money if measures are based on sufficient and effective monitoring.

7.2.4. Establishing a Programme of Measures

Based on the identified risk areas, Member States will establish a Programme of Measures. The costs involved are purely administrative. Despite several attempts, it was not possible to gather information on the administrative costs of adopting a programme of measures for EU 25. Therefore they could not be further monetised.

The implementation of these programmes, once they are adopted, involves taking appropriate measures to meet the level of ambition and targets set therein. As mentioned, above Chapter 8 provides a general *qualitative* analysis of the impacts of possible measures, while Annex 1 provides a scenario-based *quantitative* analysis of their impacts.

7.3. Establishment of an inventory of contaminated sites and of a National Remediation Strategy

7.3.1. The inventory of contaminated sites

This measure would require Member States to identify and include in an inventory the contaminated sites in their national territory. Table 5 presents the main steps that could be followed to set up such an inventory. The process starts by establishing a definition of contaminated sites and by the identification of the potentially contaminated sites through a list of potentially contaminating activities, followed by a more in depth analysis to assess if contamination really occurs and if there is risk for human health and the environment.

The definition of contaminated sites

Two options for the definition of contaminated sites to address contamination have been considered:

- a definition based purely on the concentration of contaminants in the soil,
- a definition based on risk to human health and the environment.

With regard to the first of these options:

- Advantages: with a definition based on concentration values, the identification of contaminated sites would be more straightforward (analytical analysis and no risk assessment), and more transparent, though the maximum concentration limit values would also be risk based, and there would be no need for a long term monitoring of the evolution of the risk.
- Disadvantages: a definition based on concentration values would imply that the number of sites falling under the scope of this definition could be much higher and the costs of the management of the contaminated sites would also be much higher. Issues could also arise concerning naturally occurring concentrations above limit values.

With regard to the second:

- Advantages: this definition would allow making a prioritisation of the sites based on risk which would allow managing historical contamination without disproportionate costs.

- Disadvantages: a risk based approach requires long term monitoring to survey if the land use and the risk has changed, it also can trigger some public opposition as the notion of risk is perceived sometimes (e.g. by the public and insurance companies) as a softer or subjective approach which entails more uncertainty.

Currently, the majority of the Member States, which have legislation on soil contamination, use a risk based definition where the risk is assessed taking into account the current use of the land. It is proposed to take this second option.

Establishment of a list of soil polluting activities

The list of potentially polluting activities is used as a management tool in order to identify and locate sites where there is a risk that contamination has occurred. Introducing a common and comprehensive list ensures a wider coverage and a systematic and coherent approach and avoids that many contaminated sites may be missed in the inventory because the activity causing them was overlooked.

Some Member States have established at national level a list of potentially polluting activities to address soil contamination. Nevertheless, an analysis of the activities included in some of these national lists[85] revealed that there are large differences between these countries, though some industrial and commercial activities were common to all the lists.

A common list of potentially polluting activities would overcome the differences between Member States and would provide a common approach for the same sector across the EU, thus precluding a distortion of competition.

Establishment of an inventory of contaminated sites

Thirteen Member States have already started to draw up their inventory of contaminated sites, but none has finished yet. The differences in progress between Member States are very significant.

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85 Data provided to the Environment DG by the Ministries of Environment of Spain, Finland, Sweden, and Flanders.

Table 5: Steps to set up an inventory of contaminated sites[86]

Preliminary survey	On the basis of available information, a preliminary survey has the aim of assessing whether potentially polluting activities have taken place and whether contamination can be expected. As a result of the preliminary survey, a site will, in most cases, be classified as potentially (suspected to be) contaminated or not contaminated.
Preliminary site investigation	Preliminary investigations are carried out to confirm the existence of contamination. In most cases, the results of the preliminary investigation form the basis to definitely classify sites as being contaminated. A variety of issues will influence the results of a preliminary investigation, as for example: sampling patterns, number and type of samples, depth of the boreholes, quantity of the samples, transport and storage of samples, selection of substances to be analysed, treatment of samples.
Main site investigation	A main site investigation is carried out to determine the need for remediation or other measures to eliminate or reduce exposure to the contaminants. Major goals are: – to define the extent of the contaminated area and the degree of contamination; – to assess the risks of the involved impacts.
Remediation activities	This covers the time from the start of taking measures to reduce the environmental impact to the moment that monitoring of environmental media has proven that the agreed remediation targets have been met.

Costs

The preliminary survey represents the very start of the inventory process. It consists mainly of a desk study on available information, based on which potentially contaminated sites are identified. According to the Soil Framework Directive, this stage will be needed to be carried out within 5 years after its transposition.

For this first phase, the total costs for EU25 could be monetised on the basis of available information from:

- 13 Member States which have already carried out or are currently carrying out such a preliminary survey, and

- the Dutch inventory 'Landsdekkend Beeld', which is basically a desk study. Available information was used to carry out an extrapolation for EU25 on the basis of artificial surface.

It is assumed that the 13 Member States mentioned above have already accomplished on average about 25% of the total identification of contaminated sites and that they will in any case carry out this work since they have already started (see Annex 1).

Therefore, expenditure already incurred by these Member States has been subtracted from the total costs. The estimated total additional costs for the preliminary survey are €255 million or €51 million per year for EU25 for the first five years after the transposition of the Soil Framework Directive. Table 6 shows the results.

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86 Management of contaminated sites, EEA Technical Report No 81/2002.

***Table* 6: Estimated additional costs to establish a preliminary survey (first five years)**

Costs of preliminary survey	€680 million (a)
Expenses already incurred and identification already carried out by 13 Member States (25% of the total)	€170 million (b)
Already planned expenditure in Member States is 50% (since 13 Member States will continue)	€255 million (c)
Additional costs for EU25 (a - b- c)	**€255 million or €51 million per year (for five years)**

This first stage, preliminary survey, will be followed by a second stage, the preliminary site investigations to confirm the actual presence or absence of contaminants on the identified potentially contaminated sites.

Based on the outcome of the preliminary site investigation, the sites can be identified where the concentration levels of dangerous substances are such that there may be sufficient reasons to believe that they pose a significant risk to human health or the environment. On these "*suspected"* sites, as a third stage; *full site investigations*, will have to be carried out, including a risk assessment, to conclude if there is indeed a serious risk to human health or the environment. If so, then the site will be classified as contaminated sites and introduced in the inventory.

For the second and third stages of the inventory, the estimate of the costs for EU25 ideally should be made by multiplying:

> the number of "*potentially* contaminated sites" x average costs of preliminary site investigation [€1,300 to 4,900, average €3,100]

and by multiplying

> the number of "*suspected* contaminated sites" x average costs for full site investigation (incl. on-site risk assessment) [€5,200 to 19,600, average €12,400].

However, at present the number of potentially contaminated sites, let alone the number of contaminated sites, for EU25 is unknown. Therefore, to illustrate possible costs for site investigations, Annex 1, part 2 provides an estimate of the additional annual costs based on a scenario approach. According to the outcome of this scenario, the annual additional costs for the site investigations may amount *up to* €240 million for EU25 for the full 25 year period provided for the completion of the inventory. The additional annual costs of the inventory of contaminated sites are summarized in Table 7.

***Table* 7: Estimated annual additional costs for EU25 to establish a complete inventory of contaminated sites**

Costs of preliminary survey	**€51 million per year for the first 5 years**
Costs of preliminary and main site investigation	**Up to €240 million per year for 25 years**

These estimated costs must be regarded as an upper bound estimate for the following reasons:

- The estimated number of (potentially) contaminated sites used to calculate the costs of site investigations is likely to be high as compared to other estimates.

- This estimate is based on the assumption that every site that appears on the list of potentially contaminated sites needs preliminary site investigations to assess whether or not the concentration levels of dangerous substances are such that there may be sufficient reasons to believe that they pose a significant risk to human health or the environment. Subsequently it is assumed that at every site where this appears to be true a main site investigation including an on site risk assessment has to be carried out. Over time however, due to clustering of site investigations, and the concurrent development of:

  – expert judgement based on experience,

  – the development of alternative investigation techniques (such as based on remote sensing) and

  – statistical analyses,

  risks are likely to be assessed alternatively[87]. As a consequence, the number of sites to be investigated individually is likely to drop significantly, and thus will be the costs of the inventory of contaminated sites[88].

In total, for the first five years after the transposition date the costs are €51 million to carry out the preliminary survey + a maximum of €240 million per year for site investigations, resulting in total costs ranging from €50 million to €290 million per

87 In the Netherlands for instance, originally more than 100,000 sites on a total of more than 725,000 were on the list of potentially contaminated sites because of the presence of domestic fuel tanks (Ministerie van VROM (2005) Evaluatie Bodemsanering: Analyse landsdekkend beeld). Since these sites appear hardly to be contaminated, it is considered to be inefficient to investigate the remaining sites and to redirect site investigation budgets to sites that are likely to be seriously contaminated. Instead, these sites are classified as probably not (seriously) polluted sites. To be on the safe side, however, these sites remain flagged in the information system to alert any owner or prospective buyer that there may be a problem concerning soil contamination.

88 In the Dutch example, from the originally circa 425,000 potentially contaminated sites, it is expected that after preliminary survey, 'only' about 15% or 60,000 sites will need site investigation and subsequent remediation (see figure 21 in the Dutch report referred to in the previous footnote).

year. For the remaining period, i.e. years 6-25 after the transposition date, the additional costs to complete the inventory of contaminated sites amount to a maximum of €240 million per year.

It should be noted that these costs will not be evenly distributed among Member States as some are already very advanced in their inventory, others will have to make bigger efforts

Benefits

The inventory of contaminated sites allows Member States to:

- address soil protection and combat soil contamination systematically, effectively and efficiently,
- stimulate sustainable use of soil, and allow for a prioritisation of the actions and the risk reduction measures,
- save costs so far borne by society by adopting risk reduction measures more swiftly and avoiding further contamination as the risk to human health and the environment from these sites will be known,
- add to the value of the information on soil quality which will lead to higher selling prices (benefit seller) and a less worried or uncertain neighbourhood if a potentially contaminated site turns out not to be contaminated. This benefit, however, could not be monetised within the scope of this impact assessment.

7.3.2. Establishing a National Remediation Strategy

Based on the Inventory of contaminated sites, Member States will establish a National Remediation Strategy. The costs involved are purely administrative. Despite several attempts, it was not possible to gather information on the administrative costs of adopting a programme of measures for EU 25. Therefore they could not be further monetised.

The implementation of these strategies, once they are adopted, involves taking appropriate measures to meet the level of ambition and targets set therein. As mentioned, above Chapter 8 provides a general *qualitative* analysis of the impacts of possible measures, while Annex 1 provides a scenario-based *quantitative* analysis of their impacts.

7.4. The establishment of a soil status report

This obligation requires Member States to ensure that when selling a site, on which a potentially soil polluting activity has taken or is taking place, the seller or the prospective buyer would have to provide the competent authority and the other party in the transaction with a soil status report.

This report would include background information on the site and a chemical analysis determining the concentration levels of certain dangerous substances in the soil (limited to those substances that are linked to the activity that takes/took place).

Objectives

The objectives of this provision are several:

– **public interest**, as the obligation to transmit the information on the status of the soil to the competent authorities will contribute to improving and accelerating the identification of contaminated sites.

– **sharing of the burden of identification**, as the seller or the prospective buyer, who have an economic interest in the sale, will absorb a small share of the costs of the identification of contaminated sites and this burden will not only be borne by the public authorities, who otherwise would have to carry out all the investigations.

– **prevention of contamination,** as the owner of such type of site would be more likely to take preventive measures during the operation of the activity knowing that the status of the soil will be made known to the competent authority and a prospective buyer if the owner decides to sell the site.

– **transparency and certainty about the transaction**, to the profit of both the buyer and the seller, because the prospective buyer will be able to make an informed purchase and the seller will increase the certainty on the value of the land.

In short, this is a market based instrument to contribute to the environmental goal of identifying risk to human health or the environment stemming from soil contamination.

A very similar precedent exits in Community legislation with the obligation for the seller of a house or a building to provide an energy certificate to the prospective buyer[89].

Applicability of the obligation

Most of the potentially polluting activities for which a soil status report would be required are fairly big installations (capacity and size thresholds are included in their definition). Basically, it would be mainly applicable to installations covered by the IPPC or the Seveso II Directives. Therefore, this obligation will only be triggered for a limited number of land transactions and is unlikely that it would be triggered for residential households. More crucially, the financial value of transactions involving large installations will be orders of magnitude higher than the financial cost of the soil status report (see costs below).

89 Article 7 in Directive 2002/91/EC (OJ L 1, 4.1.2003, p. 65).

7.4.1. *Qualitative analysis of environmental, social and economical impacts of establishing a soil status report*

Positive

- More information is produced on the location of former soil polluting activities and of the status of the soil which is fed to the public administration, hence speeding up enormously the establishment of the inventory and sharing the costs of identification and investigation between the private and the public sectors. For instance, in Flanders a soil status report has to be filed when sites are sold if the current or historical land use on the site included potentially contaminating activities. At this moment about 4,000 to 5,000 new soil status surveys are carried out per year which is about 5% of the estimated total amount or investigations needed.

- As a result of a quicker inventory, hazardous situations can be identified in an earlier stage and appropriate measures can be taken sooner.

- More information is available for land transactions. The purchaser of a piece of land becomes more knowledgeable of the state of the land and of possible liabilities he might be inheriting. Land transactions become more transparent.

- The obligation of producing a soil status report for a land transaction will be a driving force for land owners to take preventive measures to avoid soil contamination which would be otherwise reflected in the report.

Negative

- It entails increase costs for the seller of sites where potentially contaminating activities have taken place, which are a shift of some of the costs for site investigation from the public authority to the seller.

- Low additional administrative burden. Indeed, the burden on public administrations to handle the soil status reports received is not likely to be significant as the proposal does not require Member States to set up new structures to deal with the inventory of contaminated sites, to which the soil status report is closely linked.

7.4.2. *Quantitative analysis and monetisation on the impacts of a soil status report*

Costs

Several types of site investigation may form the basis for the soil status report:

- Option 1: A “historical” description of the site with background information on the soil polluting activity, for which the costs could vary from €30 per site (just checking the cadastre or official records) to several hundred euros per site (a desk study of old permits and archives).

- Option 2: A “historical” description combined with a chemical analysis of certain substances in the soil (comparable with a preliminary site investigation).

For option 2 an average price of €1,300 to 4,900 per site has been estimated. For very large sites and sites with complex contamination the costs can however be higher.

The kind of soil polluting activities linked to this obligation are most of them seated in large industrial sites, for which the price of the transaction is likely to be much higher than the costs for option 2. Hence this obligation will not have a bearing on the land transaction, nor have an effect on the amount of transactions. Therefore this option was chosen.

If anything, the existence of a soil status report brings certainty to the transaction. According to a Danish study[90], the fact that a site is contaminated does not have a strong effect on its selling price. The decisive factor is the *uncertainty* surrounding the characteristics of a site: the higher this uncertainty, the lower the price, and vice versa.

The soil status report is meant to contribute to the inventory of contaminated sites (section 7.3.1), both financially and by speeding up the process. This means that any soil investigations carried out within the scope of the soil status report would otherwise have to be carried out within the scope of the inventory.

The estimate of the costs of the inventory include the costs of all investigations needed; therefore the costs of the soil status report are not additional costs but have already been counted in the costs of the inventory. As mentioned before, these costs represent only a shift from public to partially private funding of the inventory.

Benefits

The soil status report brings certainty to the transaction and to the real value of the land. Hence it will lead, for instance, to higher selling prices (benefiting the seller) if the site turns out not to be contaminated or will prevent subsequent claims (benefiting both buyer and seller) if the site turns out to be contaminated to such an extent that extra costs for the management of the site have to be made. This benefit, however, could not be monetised within the scope of this impact assessment.

Savings and shift of costs

By requiring the seller or the prospective buyer to undertake this analysis of the status of the soil and to inform the public authority and the other party in the transaction, the public authority will save a significant amount of money in completing the inventory of contaminated sites. Further to its environmental benefit, the land status report represents a more efficient use of financial resources.

It is left to the discretion of the Member States to decide if it is the buyer or the seller who provides the soil status report. However, if the seller has to provide it, a more efficient use of resource is accomplished. Indeed, the UK has evaluated[91] that £1 million (about €1.5 million) *a day* is wasted on failed transactions as prospective buyers often spend hundreds of pounds on valuations, legal advice and searches and transactions that ultimately break down. While this figure concerns transactions of

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90 Miljøprojekt nr 1046, 2005 - Værditab ved salg af forurenede eller tidligere forurenede ejendomme med helårsbeboelse.

91 http://www.odpm.gov.uk/index.asp?id=1161342.

homes and not industrial sites, it gives an indication of the order of magnitude of the amount of money lost in failed land transactions.

7.5. Impact of a mechanism to fund the remediation of orphan sites

The establishment of a financing mechanism for orphan sites will result in a self-feeding mechanism based on economic instruments to be decided by Member States.

7.5.1. Qualitative analysis of environmental, social and economical impacts

Positive

- Such mechanisms will guarantee that the funds for taking measures to remediate and protect human health and the environment on orphan sites will be available when they are needed, which allow sustaining a remediation strategy in the medium and long term.
- Such mechanisms will also stimulate the redevelopment of brownfields (which often are orphan sites) thus preventing the depletion of greenfield sites.

Negative

- Depending on the instrument or mechanism chosen by the Member State, there can be some financial implications for some economical sectors.

7.5.2. Qualitative analysis of establishing a mechanism to fund the remediation of orphan sites

Costs

There will be no increase in the total cost for the management of contaminated sites as a result of the establishment of a mechanism for financing the remediation of orphan sites. Creating a special mechanism will however lead to a shift in the way budget for the management of contaminated sites is put together.

At the moment there is no information on the number of orphan sites in EU25. An estimate is made using the information on the current land use of contaminated sites. Many derelict sites are likely to be "orphan sites" as well many of the contaminated sites in residential areas (10 to 50% of the total number of sites) because the soil polluting activities have taken place there a considerable time ago and it is very likely that the polluter can no longer be found or cannot be held responsible.

Benefits

It was not possible to make an accurate quantification of the benefits.

7.6. Limitation of sealing by giving priority to the rehabilitation of brownfield sites and the use of soil saving construction techniques

As regards soil sealing, a severe lack of data made it impossible to assess the impacts in this impact assessment. However, the Commission will assist Member States in the implementation of the provisions of the proposed Soil Framework Directive with regard to soil sealing, including the initiation of activities to develop best practices.

7.7. Awareness raising

Efforts to raise awareness, to better integrate soil into other sector policies and to foster research, in particular on biodiversity, are not assessed here as they are general recommendations of an inspirational nature under the strategy and the degree of uptake by Member States is difficult to predict.

7.8. Summary of impacts of obligations specified in the Soil Framework Directive

Table 8: Summary of impacts of obligations specified in the Soil Framework Directive

Additional annual costs (rounded figures)	**Annual benefits**
Establishment of risk areas: less than € 2 million per year for EU25 Establishment of a preliminary inventory of contaminated sites: € 51 million per year for EU25 for the first 5 years Site investigations to complete the inventory of contaminated sites: up to € 240 million per year for EU25 for 25 years Soil status report: included in the costs for carrying out the inventory of contaminated sites Establishment of a funding mechanism for orphan sites: nil **Total annual additional costs (rounded figures):** **€50 - 290 million per year for EU25 for the first 5 years** **up to €240 million per year for EU25 in years 6-25** **€2 million per year for EU25 thereafter**	The benefits of gathering this knowledge of where the problem is could not be quantified but are described in a qualitative manner. Establishment of a system allowing Member States to identify the problem will allow them to: - address soil protection and combat soil threats systematically, effectively and efficiently, - adopt more targeted and efficient measures - plan in the mid and long term their strategies to combat soil degradation in their territory - stimulate sustainable use of soil, and take a preventive approach thus saving costs so far borne by society to a far greater extent than the additional costs of the Soil Framework Directive.

8. QUALITATIVE ASSESSMENT OF THE IMPACTS OF POSSIBLE MEASURES TO BE TAKEN BY MEMBER STATES

The proposed Directive will require Member States act upon the soil degradation processes identified by taking specific measures. As mentioned earlier, the choice of measures is left to Member States. The package of potential measures will greatly differ for each Member State or region and so will their impacts, costs, benefits and cumulated effects. Therefore, any meaningful impact assessment of the implementation of the proposed course of action – i.e. implementation of

Programmes of measures and National remediation Strategies – can only be undertaken at national or regional level.

Nevertheless, all measures should in principle aim at the same objective of protection of the soil functions and prevention and mitigation of the soil threats, to a higher or lower degree. Thus, q*ualitatively*, the impacts of possible measures, in terms of environmental improvement and economical or social may be similar. The Commission has made an attempt to make a *qualitative* analysis of those, which is presented in this chapter.

For a *quantitative* assessment and a *monetisation* of impacts of possible measures that Member States could opt for, an analysis based on different scenarios had to be chosen. The results of this effort are presented in Annex 1 only for illustrative purposes and in order to support and facilitate the decision making process. Due to their highly speculative nature, the scenario-generated figures are under no circumstances to be looked at as the real implementation costs of the Soil Framework Directive.

The Directive does not establish who bears the costs. The Member States decide who bears the costs. Depending on the funding schemes Member States will adopt in their Programmes and Strategies, costs will be borne by land users, economic sectors, or the public or EU budget.

For instance, as regards erosion, organic matter decline and compaction, there are two possibilities provided by the CAP:

- Cross-compliance mechanism: As a condition to receive direct payments, a farmer must ensure that land used for production purposes is maintained in good agricultural and environmental condition. Member States have to set minimum requirements as regards erosion, organic matter and soil structure.

- Rural Development: In order to enhance the environment, support is given to ensure the delivery of environmental services by agri-environment measures in rural areas, and to preserve land management. Co-financed activities clearly target EU priorities.

Member States can decide

- that the farmers bear the full costs (e.g. include the measures under cross-compliance),

- to co-finance the measures (e.g. use the possibilities under rural development to fund some of the measures with EU funds).

As regards historical contamination, the polluter pays principle applies (with or without the new Soil Thematic Strategy), hence the question of who will bear the costs is ruled by national liability regimes (as the Community liability regime which will enter into force in 2007 will not apply retroactively to historical contamination).

Therefore it is left to Member States. Some possibilities of EU funding exist for remediation of contaminated sites under the structural funds.

8.1. General qualitative impacts of measures against erosion, organic matter decline, salinisation, compaction and landslides

Environmental impacts of anti-erosion practices in agriculture

Positive impacts

- *Use of non-renewable resources:* reduction of the land necessary for production of food and other agricultural and forest products.
- *Water quality and resources:* more regular flow of both groundwater and rivers, resulting in more reliable water supply and less pollution and sediments.
- *Climate:* reduction in carbon dioxide and other greenhouse gases emissions and use of energy due to less machinery use (reduced tillage) and contribution to carbon sequestration (due to f.i. land use changes from agriculture to forestry).
- *Biodiversity, flora, fauna:* greater stability and better structure of soils will bring benefits to soil biodiversity and landscape preservation.
- *Likelihood or scale of environmental risks:* reduction of flood and landslide risks.

Negative impacts

- *Water quality and resources:* minimum tillage usually leads to the application of more herbicides, potentially polluting water and soil.
- *Land use & biodiversity:* decline in the amount of sediment reaching wetlands in river deltas may contribute to the decay of wetlands with consequences for the species depending on them.

Environmental impacts of practices in agriculture to avoid loss of organic matter

Concerning measures for combating SOM decline it should be noted that not all types of organic matter have the potential to address this threat. A distinction is to be made between organic soil improvers, such as manure and compost, and organic fertilisers, such as slurry and sewage sludge. Only the former have the potential to be transformed into humus which improves soil properties.

Positive impacts

- *Water quality and resources:* improved soil structure, and increased infiltration and water-holding capacity of the soil, leading to better recharge of groundwater aquifers and improved water quality.
- *Soil protection:* optimum SOM content leads to improved soil fertility and soil structure.
- *Climate:* improved carbon sequestration, contributing to mitigate climate change impacts
- *Renewable or non-renewable resources:* minimum tillage leads to reduced use of fossil fuel.
- *Biodiversity, flora, fauna:* increased biological activity and possibly improved soil biodiversity.

- *Likelihood or scale of environmental risks:* due to reduction of soil vulnerability to erosion, the risk of floods and landslides will diminish.

Environmental impacts of practices in agriculture to avoid compaction

Positive impacts

- *Water quality and resources:* less compaction means better infiltration of rainwater, recharge of groundwater aquifers, and hence a more regular flow of both groundwater and surface streams. This more regular flow (and less surface runoff) also means that the transport of pollutants from the area of origin to other areas downstream will be reduced – thus, the quality of the water also improves. Reduced stock densities also mean less nitrate and other pollutants entering the water bodies.

- *Soil protection:* improvement of soil structure and reduction of erosion risk.

- *Climate:* reduction in carbon dioxide and other greenhouse gases emissions due to less machinery use (reduced tillage) and reduced stocking rates, and contribution to carbon sequestration (due to f.i. land use changes from agriculture to forestry).

- *Biodiversity, flora, fauna:* increased biological activity due to better soil structure.

Environmental impacts of practices in agriculture to avoid salinisation

Positive impacts

- *Water quality and resources:* improved drainage results in increased and more regular flow of water, reduction of irrigation water demand.

- *Biodiversity, flora, fauna:* improvement of the soil biological potential and biodiversity of soils, positive effects on landscapes due to reduction of desertification.

- *Likelihood or scale of environmental risks:* improved drainage will diminish flood risks.

Negative impacts

- *Water quality and resources:* Increased salinity of drainage water, including resulting from flushing soils.

- *Biodiversity, flora, fauna:* Loss of habitats for specific halophytic species.

Environmental impacts of forestry practices to combat the soil threats

Positive impacts

- *Water quality and resources:* benefits to water quality and water quantity from catchments under forest.

- *Soil protection:* protection of forest soils and agricultural land downhill.

- *Climate:* improved carbon sequestration due to better tree growth.

- *Biodiversity, flora, fauna:* higher general biodiversity, including soil biodiversity, and protection of forest landscapes.
- *Likelihood or scale of environmental risks:* reduction of flood risks, and lower surface runoff will also diminish the risk of landslides.

Negative impacts

- *Biodiversity, flora, fauna:* restriction of deadwood to make the forest less sensitive to fire may result in lower biodiversity.

Environmental impacts of construction practices to combat the soil threats

Positive impacts

- Construction practices to combat erosion have very similar positive impacts as measures seen previously for agriculture erosion. They are different in the sense that they are more localised and often occur in urban areas.

Economic impacts of anti-erosion practices in agriculture

Positive impacts

- *Economic growth:* conservation of a natural resource, positive on-site effects as increase in yield and fertility, positive off-site effects on water infrastructure, especially dams and other water reservoirs, due to less sedimentation (reduced dredging costs and maintenance costs).
- *Human capital formation and employment:* additional positive employment effects will result from the need to carry out and maintain erosion control works.
- *Innovation:* the measure will lead to technical and institutional innovation on how to prevent erosion.
- *Micro-economic effects:* additional investments in soil conservation will lead to long-term increase and maintenance in soil productivity hence and increase in yield in the longer term. In the short term some measures (e.g. no tillage or measures against compaction) may entail some savings for the farmers (less use of fuel and machinery).
- *Water treatment:* less water treatment due to lower sediment load and reduced contamination.

Negative impacts

- *Human capital formation and employment:* less need for dredging sediments may entail less labour required in that sector.
- *Micro-economic effects:* for some measures, not for all, the production costs for farmers may increase in the short to medium term, but reduced in the longer term due to higher soil productivity. Nevertheless farmers may receive compensations for specific measures (e.g. under agri-environment or other Rural Development measures).

Economic impacts of practices in agriculture to avoid loss of organic matter

Positive impacts

- *Economic growth*: improved soil productivity.

Negative impacts

- *Human capital formation and employment:* less intensive agricultural production may entail less labour required.

- *Micro-economic effects:* for some measures, not for all, the production costs for farmers may increase in the short to medium term, but reduced in the longer term due to higher soil productivity.

Economic impacts of practices in agriculture to avoid compaction

Positive impacts

- Price levels and stability: demand for low-impact machinery will increase.

- Higher income for farmers: on site benefits of practices to prevent compaction have been estimate to be €1 billion per year for EU25[92].

- *Innovation:* technical innovation in the development of low-impact machinery.

- *Micro-economic effects:* there will be a long-term increase in output and reduction of fuel use.

Economic impacts of practices in agriculture to avoid salinisation

Positive impacts

- *Economic growth:* irrigation works maintain their utility. Better and more efficient use of water, hence less costs in water consumption.

- *Human capital formation and employment:* prevention of land abandonment and related unemployment due to desertification.

- *Innovation:* innovation in irrigation and drainage techniques.

- *Micro-economic effects:* Long term increase in yield.

Negative impacts

- *Micro-economic effects:* Increased investments in better irrigation techniques and equipments. In the short term, nevertheless such investments may take place in any case with the aim of achieving a more sustainable use of water

92 TAUW report, considering different studies on the effects of compaction on yield. This calculation limits itself to effects resulting from low-pressure tyres, meaning that the real value is likely to be even higher.

Economic impacts of forestry practices to combat the soil threats

Positive impacts

- *Economic growth:* physical capital, especially dams and water supply infrastructure, are protected from damage by erosion. Forest would be less prone to suffer from fire, hence generating saving from fire prevention.
- *Human capital formation and employment:* additional labour may be needed to carry out and maintain erosion control works.
- *Innovation:* more knowledge on erosion in forests and how to prevent it will be generated.
- *Micro-economic effects:* long-term increase in yield.

Negative impacts

- *Micro-economic effects:* some measures may entail a short-term increase in production costs.

Economic impacts of construction practices to combat the soil threats

Positive impacts

- *Economic growth:* physical capital, such as roads, water supplies, buildings, dams and farms, is protected from damage by erosion.
- *Innovation:* improvement of technical means to control erosion.
- *Micro-economic effects:* an increase or maintenance of the value of real estate property.

Negative impacts

- *Price levels and stability:* increased costs of construction in erosion-prone areas. This may have a minor effect on the availability of building and developing land and therefore on construction costs, nevertheless that is unlikely as the costs of combating erosion in construction sites are minor compared to construction costs.

Comparing the qualitative impacts

The qualitative impacts of possible measures considered to combat soil erosion, SOM decline, compaction, salinisation and landslides can be summarised as follows:

Measures will generally result in large environmental and economic benefits, mostly by avoiding public abatement costs in the short term and increased soil productivity in the longer term. Negative environmental effects are mainly limited to an increased use of herbicides in reduced-tillage systems. The social impacts of all measures tend to be small.

8.2. General qualitative impacts of the management of contaminated sites

Environmental impacts

Positive

- *Soil protection*: the management of contaminated sites will improve the quality of the soil and ensure the protection of its functions.
- *Water quality and resources*: managing the contaminated sites will contribute to improve the quality of surface water, groundwater and drinking water by eliminating a pressure on the chemical and ecological status of these resources. The quality of surface water and groundwater is addressed by the Water Frame Directive and the Groundwater Directive, and the proposed measure will help to achieve the targets therein.
- *Biodiversity, flora, fauna*: a better quality of soil will bring benefits to soil organisms and to organisms living on these soils, to growing plants and to the ecosystem functioning as a whole.
- *Human safety and health:* identification and remediation of contaminated sites will allow to avoid the spread of harmful substances to the environment (especially groundwater but also air) will decrease health problems by reducing the direct human exposure to the contaminants (through dust, inhalation of volatile chemicals and direct intake of soil by children) as well as the indirect exposure (through the food chain and drinking water).
- *Land use*: identification and the remediation of contaminated sites will bring less restriction on land use, hence more land will be available for different human and economic activities. More land availability is a factor on sustainability in the EU. The remediation of contaminated sites will decrease restrictions in land use especially in urban areas, allowing for the redevelopment of brownfield sites and thus preventing the depletion of greenfields. Given the scale of the contaminated sites compared to the overall real state market, the higher availability of land after remediation will have a positive local effect but it is unlikely that it will lead to a decrease in overall land prices at a regional or national scale. Remediated soil may also be used as construction product.

Negative

- *Natural or cultural heritage*: the excavation of contaminated soil for treatment might destroy or damage natural structures (geomorphology) or archaeological structures.
- *The use of energy*: the excavation, transport and treatment of contaminated soil will require energy. This will however be negligible compared to the total use of energy and should therefore be considered only a minor impact.

Economic impacts

Positive

- *Price levels and stability*: the management of contaminated sites will have a positive effect on the price of land or at least correct the negative effect as a result of the contamination. A recent study[93] has shown that that biggest factor for land value depreciation is the uncertainty about the soil contamination and the possible risk. Hence the identification, certainty and management of the risk of the contaminated sites will correct this negative depreciation.

[93] Miljøprojekt nr. 1046, 2005 - Værditab ved salg af forurenede eller tidligere forurenede ejendomme med helårsbeboelse

- *Human capital formation and employment:* Money invested in investigation and remediation of contaminated land will result in new jobs in the public sector (government and science) and in the private sector (mainly for contractors and consulting engineers). A study in Denmark, using a specially created model, concludes that each time 100 million DKK (about €13.5 million) of public money is invested in contaminated sites, 230 new jobs are to be expected.

- *Innovation*: the process of site investigation and remediation will have a positive effect on technical innovations and R&D investments in environmental technology. New remediation techniques and technology will in the long term lead to a cheaper remediation of contaminated sites. Knowledge of the costs caused by historic pollution can stimulate investment in technology to prevent future contamination.

- *Microeconomic effects on enterprises, non-profit organisations etc.*: the improvement of soil quality in agricultural areas would lead higher yield and better quality of agricultural product

Negative

- *Effects on public authority budgets*: for the Member States which have not started to address the management of contaminated sites, these will require allocating more public budgets for site identification and remediation.

- *Microeconomic effects on enterprises:* applying the "polluter pays principle" will mean that the management of contaminated sites, in the Member States that have not tackled the issue, would lead to an increase of the "polluters" costs due to the obligation to remediate the contaminated sites. High remediation costs could influence the availability of firm financing. Nevertheless this would only constitute an new impact in the case of the remediation of historical contamination occurred before the entry into force of Community legislation on environmental liability, as the latter already requires remedial actions for such damage.

Social impacts

Positive

- *Public health*: the management of contaminated sites will positively affect the health of individuals, especially for risk groups like children and senior citizens living on or near contaminated sites by reducing direct (dust, intake by children) and indirect (drinking water, food chain) exposure to dangerous substances. It would also have a positive effect on the working environment for people working on contaminated sites.

- *Creation of jobs*: A study in Denmark, using a specially created model, concludes that each time 100 million DKK (about €13.5 million) of public money is invested in contaminated sites, 230 new jobs are to be expected. This estimate does not take into account the displacement effects.

- *Consumer interest*: the management of contaminated sites can have a positive effect on food safety by identifying risk areas (contaminated areas where food is produced) or by remediating contaminated sites. It will also have a positive impact on consumers/buyers of land who will be aware and knowledgeable if the land they are purchasing is classified as a contaminated site.

Negative

- Cultural heritage: the excavation of contaminated soil for its treatment may damage archaeological sites.

9. MONITORING AND EVALUATION

9.1. Core indicators of progress to meet the objectives

With regard to the objectives of the strategy described in chapter 5, the following indicators seem suitable to measure its progress:

- Changes of areas at different risk categories,
- Location and number of contaminated sites (and potentially contaminated sites),
- Extent, effects and efficiency of measures undertaken to combat erosion, SOM decline, salinisation, compaction and landslides,
- Progress of remediation strategies.

Additional information from national activities (risk identification and programmes of measures/remediation strategies) of particular relevance to evaluate the strategy would include information on:

- Changes of pressures and driving forces in the identified risk areas,
- Changes in land use and in soil management,
- Changes in production processes (for the agricultural, forestry, industrial and construction sector).

9.2. Monitoring and evaluation

Information received from Member States under the following reporting obligations of the proposed Soil Framework Directive will help to generate the necessary information and ensure data exchange between Member States and with the Commission:

- Risk area identification,
- Risk acceptability,
- Measures to combat the soil threats and their efficiency,
- Inventory of contaminated sites,
- Remediation strategies,
- Measure against soil sealing.

Improved awareness on soil issues, better integration into other policies and exchange of information between stakeholders, as encouraged by the strategy, will also contribute to constantly improving the actions undertaken.

The development of a Common Implementation Strategy (CIS) for the Framework Directive and the other pillars of the strategy, in partnership with Member States, while maintaining an open dialogue with experts who participated in the stakeholder consultation. This will allow initiating activities to support Member States in identifying and developing the most cost-effective measures to achieve the objectives of the strategy.

ANNEX 1
Scenarios to illustrate possible implementation of the Soil Framework Directive[94]

Although not directly emanating for the legislative proposal, the Commission has made an effort to quantify the impacts of the implementation of this framework by Member States.

As risk acceptability, the level of ambition regarding the targets and the choice of measures to meet these targets are left to Member States. It is therefore very difficult to predict accurately the related costs of the possible measures. The monetisation of the costs and benefits of such possible implementation measures is approached by defining scenarios:

- Part 1 of this Annex addresses a scenario illustrating possible implementation of the Programmes of measures against *erosion*, *organic matter decline*, *salinisation*, *compaction* and *landslides*. This scenario represents a medium level of ambition.

- Part 2 of this Annex addresses a scenario illustrating possible implementation of the National Remediation Strategies. This scenario represents a high level of ambition.

In interpreting the figures presented in these scenarios, it has to be kept in mind that any quantification of impacts, given the current lack of knowledge and data, present necessarily some limitations, hence:

- the impacts of soil degradation on ecosystem services (many soil services, notably biodiversity preservation and ensuring nutrient and gas cycles) or non-use values of the soil could neither be quantified nor monetised, therefore even the highest estimates for the costs of soil degradation fall short to include the value of losing these services of the soil;

- it is also very difficult to quantify the social off-site costs of soil degradation (borne by society and economic operators other than land users), which represent by far the largest share of the total costs of soil degradation compared to on-site costs (borne by land users).

Therefore, the real costs of degradation can be expected to exceed, and in some cases to exceed by far, the highest estimates presented here. Consequently the benefits of taking measures to prevent soil degradation can reasonably be thought to be higher.

Due to the scenario-approach generalisations are unavoidable, such as that measures to combat soil degradation apply everywhere whereas in reality measures will vary due to local, regional or national differences. Therefore, the results presented in this annex should be taken with caution.

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[94] This Annex is based on a Service Contract in Support of the Extended Impact Assessment for the Soil Thematic Strategy Proposals, ENV.B.1/SER/2004/0048 (TAUW report).

PART 1

A scenario illustrating possible implementation of the Programmes of measures against erosion, organic matter decline, salinisation, compaction and landslides

This part builds on the general qualitative impacts of measures against erosion, organic matter decline, salinisation, compaction and landslides as presented in chapter 8 of this impact assessment.

In order to quantify the impacts of possible measures it is necessary to be more precise. Therefore, a scenario is established existing of packages of concrete measures to address these threats. Both costs and benefits of these packages are quantified.

Seven packages containing each a series of specific practices were put together. Each package would represent a possible approach to combat a specific threat (erosion in high or medium risk areas, decline of SOM, salinisation, compaction etc.). Data on the costs for each practice were then derived from different sources (e.g. literature research, evaluation of Rural Development Programmes of Member States).

Each practice was then weighted within its package according to the likely area to be covered by the specific practice (e.g. terracing would be necessary only in X% of the area at risk of erosion, so the costs for terracing would be multiplied by that factor). The costs of the weighted practices were added up per measure and multiplied by the area (in hectares) where such practices seem necessary.

The costs are compared to the monetised benefits of the packages in order to obtain the net cost or benefit of the scenario.

Costs of measures already undertaken by Member States have been identified, monetised and subtracted from this balance to obtain finally the additional costs of the possible measures envisaged in the scenario.

1. QUANTIFICATION: DESIGN OF A SCENARIO AND METHODOLOGY

Not all of the impacts qualitatively assessed in the before section can be quantified, mainly due to a lack of sufficient and reliable data. Quantification had to be restricted to the on-site impacts on (agricultural) soil productivity, and the off-site impacts of sediment loads and pollution and the contribution to the reduction of greenhouse gas emissions.

Moreover, for the purpose of quantification, possible measures have to be specified. Given this, quantification has started by combining a number of every day practices (or standards) into *packages* that can be regarded illustrative for combating the specified soil threats. These are the core of the scenario

As in any scenario, it must be borne in mind that the packages represent only a selection of practices which are generally considered appropriate to a wide range of problem situations as encountered in the European Union. They are therefore not to be considered as the only ones suitable, or even necessarily the best ones in all situations covered by the package. They have to be regarded only as a scenario for the purpose of illustrating the potential costs of combating these threats. In the actual implementation of a proposed Soil Thematic Strategy, packages of measures should be designed on the basis of the local situation, usually by the land users themselves.

The costs and benefits for the scenario have been assessed using the following methodology, based on six different approaches in agriculture, forestry and construction works:

(1) Setting farming standards at field level in areas at risk of water erosion;

(2) Setting farming standards at field level in areas at risk of decline of SOM;

(3) Setting farming standards at field level in areas at risk of soil compaction;

(4) Setting farming standards at field level in areas at risk of salinisation;

(5) Setting requirements on forestry practices to enhance the positive effect of forests in mitigating erosion and improve the SOM content;

(6) Setting standards on infrastructure and other construction works in erosion-prone areas.

To monetise the impacts of the scenario, a number of practices have been selected from each of these six approaches and combined into seven packages. Each package contains a set of measures. These are:

(1) agricultural practices at field level in situations of *serious*[95] erosion (erosion risk over 10 tons per hectare per year)[96];

(2) agricultural practices at field level in situations of *moderate* to *serious* erosion (erosion risk 2-10 t/ha/yr);

(3) agricultural practices at field level in situations with no or *low* erosion risk, but with low rates of soil organic matter (organic carbon content below 2%);

(4) agricultural practices at field level in situations of *serious* risk of subsoil compaction (high or very high susceptibility);

(5) agricultural practices at field level for irrigated land where there is risk of salinisation;

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95 The classification of serious, moderate or low erosion is ONLY illustrative for the purpose of the analysis of impacts. Member States will decide what they consider to be serious, moderate and low in their particular circumstances and their risk acceptability.

96 Agriculture is here defined as the production of crops in fields. It thus includes perennial crops and horticulture, but not greenhouses. Short-term fallow is also included, but not pasture.

(6) requirements in forestry to minimise erosion and compaction, and enhance soil organic matter;

(7) standards for infrastructural and other construction work in erosion-prone areas.

It should be noted, that in the scenario only erosion above a soil loss of 2 tons per ha per year is addressed, because it is regarded unrealistic that Member States in general will address soil losses due to erosion at a rate of less than 2 tons per ha per year.

2. MONETISATION OF COSTS AND BENEFITS OF THE SCENARIO[97,98]

It is important to highlight that the total cost of soil protection cannot be assessed by simply adding up the costs of all practices, as they can complement each other, are alternatives, or need to be combined to have the desired effect.

Therefore, within each package, the cost of applying the selected practices is estimated on a per-hectare basis and then weighted, expressing the extent to which a practice is likely to be applied by Member States. A weight of 100% means that the practice will be applied throughout the whole area at risk considered. The per-hectare costs of the weighted practices can then be added to arrive at the average cost of the entire package – still per hectare. The next step is then to estimate the total area to which the package should be applied.

In estimating the on-site cost per hectare of certain measures, the Rural Development Programmes of Member States, containing i.a. the agri-environmental schemes, and data derived from the literature have been used as guidelines. Some of the practices involve only annually recurrent costs, but a number consist of, or include, investments. In the latter case, these investments are discounted over the period of depreciation to a maximum of 20 years, at a standard rate of 4%.

In calculating the on-site benefits, a cumulative effect needs to be taken into account. Anti-erosion and SOM enhancement practices, if maintained over a number of years, yield not only the benefit of a single year's worth of application, but that of the previous years as well. Though the first year, the benefit of may be lower than the cost, in the 20th year it may be much higher. Therefore, the total benefits over a 20-year period are annualised by discounting the total at a discount rate of 4%. This is also true for salinisation, but not for soil compaction, as those benefits accumulate for only 3-4 years[99], after which they tend to remain static.

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97 TAUW study.

98 Ecologic study.

99 Arvidson, J. and I. Håkansson, (1996). Do effects of soil compaction persist after ploughing? Results from 21 long-term field experiments in Sweden. Soil & Tillage Research, pp. 175-197.

2.1. Costs of possible measures to combat erosion, including measures against decline of SOM

Conversion of arable land into forest: This consists partly of investment (for establishment of the forest, and for protection during the first five years), and partly of annual costs in the form of loss of income. The costs have been estimated from the literature[100]), ESTAT (total revenue on arable land in the EU to be on average €1100/ha) and own expert judgement (net profit per hectare affected by such a conversion to be around €200). For forests, the net revenue is assumed to be zero, as many of those forests cannot be exploited commercially. The result of the estimate shown below in Table 1 is comparable to premia of Spain on afforestation (€270)[101], but much lower than premia in Rhineland-Palatinate in Germany (€306-715) or Flanders in Belgium (€850-3,700).

***Table 1*: Annual cost of conversion of arable land into forest (€/ha)[102]**

	Total cost	*Discounted and annualized*
Establishment (year 1)	700	
Maintenance (year 2-5)	4x150	
Total investment	1,300	88
Loss of revenue		200
Total		288

It is assumed that 8% of the serious risk erosion area (for package 1) would need to be converted to forests.

Conversion of arable land into pasture: The costs are estimated to be €200/ha on the basis of a comparison with the previous practice, and of expert judgement on planting cost, which discounted at 4% per year comes to an annualised cost of €15/ha.

100 Indiana Woodland Steward (2005). Tree Planting Costs, see: http://www.fnr.purdue.edu/inwood/tree%20planting%20costs.htm.

101 Strictly speaking, this is the central guideline contained in the Spanish Rural Development Plan. Actual subsidies are determined by the Autonomous Communities.

102 Figures in this table differ from the original tables as presented in the TAUW study due to the application of the Net Present Value method used to discount and annualise investment costs.

***Table 2*: Annual cost of conversion of arable land into pasture (€/ha)**[103]

	Total cost	*Discounted and annualized*
Establishment (year 1)	200	14
Loss of revenue		140
Total		154

The share of this practice in the package is also 8% within package 1.

Terracing: there are many different types of terracing of which the costs differ. New terrace construction is comparatively rare in Europe, but it can occur as part of land consolidation projects. Expert judgement, based on experience from developing countries but adjusted for the use of mechanical equipment, varies from 5,000-25,000 €/ha, using 12,000 €/ha as average value. It is assumed that 0.5% of all arable land with erosion of over 10t/ha/yr within package 1 will need terrace construction.

Maintenance of existing terraces is a more substantial form of soil conservation. The costs have been estimated to be around €200/ha/year, based on data from agri-environmental schemes (€75-374 in Portugal, €132 in Spain). Ten percent of high erosion risk area within package 1, corresponding to the percentage of perennial crops, have been assumed to need such terrace maintenance.

***Table 3*: Annual cost of terracing (€/ha)**[104]

	Total cost	*Discounted and annualized*
Construction	12,000	849
Annual maintenance		200

Buffer strips: on steep slopes (12-25%), a strip 3m wide every 30m has been considered for this impact assessment as a possible approach. This would mean 10% of a field would be covered, representing a loss of revenue of € 20/ha/y. In the serious erosion risk category (package 1), the annual discounted costs of the investment is estimated to be 60 €/ha (based on an investment of €800) and the maintenance costs to be 150 €/ha/y. In the moderate to serious risk erosion category (package 2) establishment costs are estimated to be 30 €/ha and maintenance at 75 €/ha/year. This estimate is modest compared to compensations paid in some Member States for similar measures.

[103] Figures in this table differ from the original tables as presented in the TAUW study due to the application of the Net Present Value method used to discount and annualise investment costs.

[104] Figures in this table differ from the original tables as presented in the TAUW study due to the application of the Net Present Value method used to discount and annualise investment costs.

***Table 4*: Annual costs of buffer strips, for different erosion risk areas (€/ha)**[105]

	Moderate to serious erosion/Category 2	*Serious erosion/Category 1*
Total costs of establishment	400	800
Discounted and annualized costs of Establishment	28[106]	57
Maintenance	75	150
Loss of revenue	20	20
Total	125	230

The share of buffer strips in the high-erosion category is put at 74%, as they will be required wherever the land remains arable and is not terraced. In the moderate to serious category, the share is 50%, meaning that this practice will be applied in half of the relevant area, as well as at lower per-hectare cost. It has to be added that buffer strips are applied not only designed for slopes, but also along rivers.

Residue management, conservation tillage and off-season cover crops: these costs have been estimated on the basis of premia paid in agri-environmental schemes. Table 5 shows the results, based on measures in Germany, Spain and Portugal.

***Table 5*: Annual cost of residue management, conservation tillage & cover crops (€/ha)**[107]

	Amount per year
payment for residue management	44
payment for conservation tillage	59
payment for cover crop	57
Total	160

Such measures will not be required in areas which are taken out of production and have limited relevance for perennial crops. Also, not all areas are suitable for cover crops or minimum tillage due to climatic and soil conditions, in for some crops such as potatoes and cabbage residues need to be removed from the land. Finally, in areas where winter crops are already grown as part of the normal rotation system there is

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105 Figures in this table differ from the original tables as presented in the TAUW study due to the application of the Net Present Value method used to discount and annualise investment costs.

106 The minimum and maximum annualized costs are based on a mix of grass and tree strips. Minimum total costs represent grass strips in areas of medium erosion risk, maximum stands for tree strips in high-risk areas.

107 This does not include any private long term benefit from improved soil productivity.

no need for a cover crop. Therefore, the percentages given within the packages are 70% for residue management, 50% for conservation tillage, and 30% for cover crops for the low- and medium to high erosion risk categories. For the serious erosion risk area, the percentage is lower because other measures are more appropriate.

Linear elements: These are landscape elements such as tree lines, boundary walls, hedges, etc., which provide protection against erosion if they are aligned with the contour. The costs have been derived from premia in agri-environmental schemes. In Wallonia, for instance, the payments vary from 10-1,000 €/ha/y. As such measures are suitable in only a limited proportion of the areas with moderate erosion risk, the percentage has been set at 25% for package 3.

Contour ploughing: According to an estimate from the US Fish & Wildlife Service, the cost of contour ploughing varies from 25-60 $/acre in 1995[108]. This is equivalent to 67-160 €/ha. However, this estimate does not include the avoided cost of conventional ploughing. Based on expert knowledge, we estimate the total costs for contour ploughing to be 20 €/ha[109] and to be applicable in 25% of the areas at moderate erosion risk.

Table 6 brings together the costs of individual practices to combat erosion by compiling the cost per package. The percentages do exceed 100%, indicating that several measures need to be taken in parallel to fully combat the threat (e.g. a particular filed could be subject to conservation tillage and at the same time to a specific crop residue management to fully prevent erosion).

***Table 6*: Annual cost of agricultural practices for erosion control[110]**

Package	*Practice*	*Measure aimed to combat*	*Cost per ha per year (€)*	*Share in package*	*Cost per ha/y for package*
1. serious erosion (>10 t/ha/yr)	conversion of arable land into forest	erosion, SOM loss	293	8%	293
	conversion of arable into pasture	erosion, SOM loss	154	8%	
	terracing (construction)	erosion	849	0.5%	
	terracing (maintenance)	erosion	200	10%	
	buffer strips	erosion	227	74%	

108 See: http://fire.r9.fws.gov/ifcc/Esr/Treatments/contour-tillingi.htm.

109 Contour ploughing is generally more expensive than ploughing up and down the slope. This is partly because on moderate slopes, laying out the exact contour is difficult, especially when graded contours are desired for better drainage; and partly because the slope gradient may interfere with the shape of the field – and working perpendicular to the boundaries is usually the most convenient way to plough. It can only be applied on moderate slopes, because of the danger of overturning.

110 Figures in this table differ from the original tables as presented in the TAUW study due to the application of the Net Present Value method used to discount and annualize investment costs.

	residue management	erosion, SOM loss	44	59%	
	conservation tillage	erosion, SOM loss	59	42%	
	cover crop	erosion, SOM loss, compaction	57	25%	
2. moderate to serious erosion (2-10 t/ha/yr)	buffer strips	erosion	123	50%	139
	residue management	erosion, SOM loss	44	70%	
	conservation tillage	erosion, SOM loss	59	50%	
	cover crop	erosion, SOM loss, compaction	57	30%	

2.2. Costs of measures to combat only the decline of organic matter

Most of the practices aimed at erosion control will also enhance SOM content (see table above). The application of exogenous organic matter (EOM), however, is suitable for areas only which are not prone to erosion. Concerning measures for combating SOM decline it should be noted that not all types of organic matter have the potential to address this threat. A distinction is to be made between organic soil improvers, such as manure and compost, and organic fertilisers, such as slurry and sewage sludge. Only the former have the potential to be transformed into humus which improves soil properties."

A few Member States have included such measures in their Rural Development Programmes (e.g. Saxony in Germany - application of lime in soils, and Emilia-Romagna in Italy - application of compost). To estimate the costs, three components need to be considered: (a) acquisition and processing of the material, being around 55 €/t, (b) transport to the farm to be on 2.40 €/t; and (c) application on the land, assumed to costs 40 €/ha. The total cost will then be 384 €/ha, assuming an application of 6 t/ha. This is significantly more than the Italian premium of € 130/ha for compost application, where on-site benefits of the farmers have probably been accounted for.

***Table 7*: Annual cost of exogenous organic matter application (€/ha)**

Item	*Amount*
Production cost per ton	55
Transport cost per ton-km	0.08
At an average distance of 30 km, per ton	2.40
Total cost per hectare at farmgate, @ 6 tons/ha	6x (55+2.4)= 344

Application cost	40
Total	384

As it might not be possible to apply this practice throughout the whole affected area (depending on the availability and proximity of compost producers, livestock and urban areas etc.) we assume that it can be applied in 10% of the areas with low erosion and low SOM.

Table 8 brings together the cost of practices to combat SOM decline by compiling the cost per package. For the other practices (conservation practices, cover crops, residue management), the same will apply as in areas of low and moderate erosion.

***Table 8*: Annual cost of agricultural practices to prevent loss of soil organic matter in areas of no or low erosion risk**

Package	*Practice*	*Threat at which it is aimed*	*Cost per ha per year (€)*	*Share in package*	*Cost per ha/y for package*
4. level areas, SOM loss only	residue management	SOM loss	44	70%	116
	conservation tillage	SOM loss	59	50%	
	cover crop	SOM loss, compaction	57	30%	
	application of EOM	SOM loss	384	10%	

2.3. Costs of measures to combat compaction

The costs of the measures to combat soil compaction are mainly reflected in changes in mechanization equipment, either the use of larger wheels/lightweight materials, or new equipment such as gantries. Information on the economic aspects of such changes is limited[111]. The Natural Resource Conservation Service (NRCS), part of the U.S. Department of Agriculture (USDA) promotes a conservation security program for a few specific regions. Activities to reduce soil compaction have a cost range from 0.50-2.00 $/acre per year (equivalent to 1 - 4 €/ha/y). Using GPS or similar equipment to reduce soil compaction has a cost range of 1 - 4 $/acre (2 - 8 €/ha)[112].

Based on information derived from the literature, low-ground-pressure machinery can be estimated to be on average 8.8% more expensive than conventional machinery, and costs for contractors are around 5% higher (due to more expensive

111 Soane, B.D., & C. van Ouwerkerk, (1994). Soil compaction problems in world agriculture. In: Soane, B.D., & C. van Ouwerkerk (eds.): Soil Compaction in Crop Production. Amsterdam: Elsevier, p. 16.

112 NRCS, (2005), see: http://www.mt.nrcs.usda.gov/programs/csp.

machinery and extra labour)[113]. Assuming that only depreciated machines are replaced by the new types, and based on FADN-data, the average machinery cost on specialized crop farms is €62.65/ha[114] and €69.82/ha for contractors, resulting in an overall cost of the measure of €9/ha and year (see Table below).

***Table 9*: Annual cost of using low-ground-pressure machinery (€/ha)**

item	*Amount per ha per year*
Cost of conventional machinery	62.65
Additional cost for low-ground pressure machines: 8.8%	5.51
Contractor cost, conventional	69.82
Additional cost for using low-ground-pressure machinery: 5%	3.49
Total additional cost	9.00

Low-ground-pressure machinery can be applied on all fields susceptible to soil compaction, except where conservation tillage is applied. As conservation tillage is already applied in 50 % of the compaction risk area under the packages against erosion and SOM decline (as risk areas overlap), the measure will not need to be applied there again but just in the remaining 50 % of the risk area.

***Table 10*: Annual cost of agricultural practices to minimise subsoil compaction**

Package	*Practice*	*Threat at which it is aimed*	*Cost per ha per year (€)*	*Share in package*	*Cost per ha/y for package*
5. specific anti-compaction practices	low-impact machinery/ low-pressure tyres	compaction	9	50%	4.5

2.4. Costs of measures to combat salinisation

Literature information on costs to combat salinisation indicate that preventive practices (such as proper irrigation and drainage systems) would costs around 6,000 €/ha, monitoring costs would be around 75 €/ha and year, and costs of restoration, drainage systems, and strategies for salt-leaching around 4,500€/ha[115]. Total

113 Janssens, S.R.M., (1991). Profitability of applying lower loads to the soil: An economic evaluation of low ground pressure systems at the farm level (in Dutch). Lelystad, the Netherlands, Research Station for Arable Farming and Field Production of Vegetables (PAGV). Report 127.

114 Based on Dutch FADN data, 75% of the annual costs of "machinery and buildings" is allocated to "machinery".

115 Crescimanno, G., (2001). An integrated approach for sustainable management of irrigated lands susceptible o degradation/desertification. Final report ENV7-CT97-0681. April 2001; Case study on Italian salinization in: Darmendrail, D., O. Cerdan, . Gobin, M. Bouzit. F. Blanchard & B. Siegele,

equipment costs of a drip irrigation system are about € 4,200/ha, while a low-capacity mini-sprinkler system costs 1,200 €/ha[116.] A study in the Ukraine concluded that fixed costs for drip irrigation are around 500 €/ha/y and variable costs around €5/m^3 [117]. Overall, and assuming that investments in drip-irrigation are done before the current irrigation equipment has been completely depreciated, the extra investment costs of drip-irrigation can be estimated to be around 5,000 €/ha. Assuming a depreciation period of 20 years this means approximately € 288 €/ha/y, to which fixed costs of 5%, meaning 250 €/ha/y, must be added.

To monetarise the costs of measures to combat salinisation, we limit ourselves to the estimation of the substitution of drip irrigation for sprinkler and surface irrigation. As the package only consists of a single measure, its share is set at 100%. The total costs per hectare are illustrated in Table 11. We have not considered the costs of drainage systems (important also in rainfed agriculture such as in Hungary) or of flushing (which is complementary to drainage). However, investments in irrigation equipment are likely to be the most expensive of all different practices to combat salinisation, and therefore our approach seems to be rather conservative.

***Table11*: Annual cost of replacing surface or sprinkler irrigation by drip irrigation (€)[118]**

	Amount per ha
Investment	5,000
Annual cost, depreciated over 20 years	250
Discounted to present value	288
Additional annual maintenance cost: 5 % of investment	250
Total additional cost over conventional irrigation, per year	604

2.5. Costs of forestry practices to combat soil threats

Reduced-impact logging (also called selection cutting) seems to be a good proxy to assess the overall costs of forestry practices to combat soil threats. This type of logging requires increased investments in the pre-felling phase for training and planning (selection of trees, logging plans), but the result is a more efficient logging operation and an optimal use of logging equipment.

(2004). Assessing the economic impact of soil deterioration: Volume II Case Studies and Database Research. Berlin: Ecologic - Institute for International und European Environmental Policy. Draft Report for DG Environment, European Commission.

116 Phocaides, A., 2001: Handbook on pressurized irrigation techniques. Rome, FAO.

117 Hellegers, P. J. G. J. and C. J. Perry, (2004). Water as an economic good in irrigated agriculture: Theory and practice. Den Haag, LEI, Rapport 3.04.12.

118 The TAUW study assumes a 10 year depreciation period with 10 % of the investment costs as maintenance costs. However, this is likely to be far too high and would exceed by far the figures for the Ukraine. Furthermore, figures in this table differ from the original tables due to application of the Net Present Value method used to discount and annualize investment costs.

According to literature information, productivities, costs, and operational feasibilities of using a ground-based, multi-entry harvesting method in second-growth Douglas-fir stands, the combined costs of felling and skidding was estimated to be 20-30% higher than conventional harvesting[119]. Comparing a large number of studies on conventional and reduced-impact logging, other authors concluded that the median logging intensity of conventional logging is 45 m^3/ha, while the median logging intensity of reduced-impact logging is 37 m^3/ha[120]. Table 12 shows that the costs per ha for reduced impact logging are 18% higher than the costs per ha for conventional logging. After accounting for yield loss differences, estimated at 8 m^3/ha or 320 €/ha, this results in total overall costs of 450 €/ha.

As this is the only measure monetised under forestry practices, it is set at 100 % of the areas, representing again a rather conservative approach.

***Table 12*: Annual cost of reduced-impact logging (€)**

Item	*conventional*	*Reduced impact*	*Difference (2-3)*
Yield (m^3/ha)	45	37	8
Revenue (€/ha) @ €40/m^3	1,800	1,480	320
Total planning, felling & skidding costs ($/$m^3$)	19.73	28.23	-8.50
Total costs in $/ha)	887.85	1,044.51	-156.66
In €/ha (€1=$1.2)	739.88	870.43	-130.55
Net yield (revenue – cost)/ha	1,060	610	450

It should be noted that the cost levels for low-impact logging seem very high on a per area basis, such as to make forest operations economically unviable. On the other hand, a relatively small total area is indicated as being at risk.

2.6. Costs of construction practices to combat erosion

The New York State Department of Environment Conservation (NYS-DEC) manual provides minimum standards and specifications for meeting criteria contained in its general permit for storm-water discharges associated with construction activity. This manual gives an extensive list of practices for reducing erosion on building sites, which have been used to assess the costs to combat soil threats (erosion) at construction sites. Table 13 shows an example for a site of 11.1 acres in North Carolina, where 6 acres (2.4 ha) with slopes between 4 and 6% is disturbed in order to construct two large commercial buildings with associated paved roads and

[119] Bennett, D.M., (1993). Partial cutting in a in second-growth Douglas-fir stand in coastal British Columbia: productivities, costs, and soil impacts. Wood Harvesting Technical Note TN-199.

[120] Killmann, W., Bull, G.Q., Schwab, O., and R.E. Pulkki, (2002). Reduced impact logging: does it cost or does it pay?, in: T. Enters et al., Applying Reduced Impact Logging to Advance Sustainable Forest Management, Bangkok, FAO.

parking area. For this site, the costs of erosion-control practices add up to 64,617 $ (= 53,847 €), an average of 22,159 €/ha.

***Table 13*: Cost of erosion and sediment control on construction sites**[121]

ITEM	*QUANTITY*	*UNIT COST*	*AMOUNT ($)*	*MAIN-TENANCE($)*[122]	*TOTAL ESTIMATED COST ($)*
1. Stabilized Construction Entrance	22.2 cu.yd.	$30 cu.yd.	666	666	1,332
2. Rock Riprap	350 cu.yd.	$45/cu.yd.	15,750	1,575	17,325
3. Seeding	2.5 ac.	$2,000/ac.	5,000	1,000	6,000
4. Grass Channel	1,100 ln.ft..	$10/ln.ft.	11,000	1,100	12,100
5. Temporary Swale	900 ln.ft.	$2.50/ln.ft.	2,250	1,125	3,375
6. Level Lip Spreader	10 ln.ft.	$25/ln.ft.	250	125	375
7. Drop Inlet Protection: a. Filter Fabric	1 ea.	$100/ea.	100	60	160
b. Block & Gravel	1 ea.	$500/ea.	500	300	800
8. Silt Fence	100 ft.	2.50/ln.ft.	250	250	500
9. Tree Protection	80 ln.ft.	$5.00/ln.ft.	400	200	600
10. Sediment Trap	1 ea.	$1,500/ea.	1,500	300	1,800
11. Sediment Basin	285 cu.yd.	$50/cu.yd.	14,250	3,600	17,850
12. Rock Outlet, Structure	2 ea.	$1,000/ea.	2,000	400	2,400
TOTAL					64,617[123]

This is an example of what the cost of erosion control may be on gently sloping sites. In Europe, geotextile matting is sometimes applied for the same purpose. These costs are roughly 10 €/m² or 100,000 €/ha. This shows that the costs quoted above are realistic. Moreover, it is but a modest fraction of the value of the buildings being constructed on the site. As this represents a number of different practices, it can be used for the entire territory under construction at risk of erosion, meaning its share in the package is 100 %.

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121 NY, 2003: 10.5, see: http://www.dec.state.ny.us/website/dow/toolbox/escstandards.

122 In this example, building takes two years, so the annual maintenance cost is required for only one year.

123 Since the cost of erosion control should be compared to the cost of the building project, there is no point in depreciating and discounting these costs.

2.7. Risk areas where the different measures will need to be applied

The costs have so far been calculated on a per-hectare basis. Therefore, these costs need to be multiplied with the area where the measures should be applied.

In order to calculate on how many hectares of EU 25 the different erosion packages should be applied, a GIS analysis has been carried out comparing land under agriculture with lands at varying classes of erosion risk according to the PESERA model[124].

No sufficient information exists on areas of SOM decline. Therefore, the "SOM package" has been multiplied by the number of hectares with low or no erosion risk and with a soil organic carbon content of less than 2%. This is acknowledged to be a rough approximation. On the one hand the area of SOM decline is likely to be higher than the areas with low or no erosion risk. On the other hand the measure may also be necessary in order to address SOM decline in areas of high SOM content to avoid loss of soil carbon in the context of mitigating climate change.

For compaction, a map of susceptibility to subsoil compaction (defined on the basis of soil texture and packing density)[125] has been used. The data demonstrate that 32% of European soils are highly susceptible to subsoil compaction[126].

For salinisation, the total area under irrigation, 14.3 million ha, has been used as a basis for the calculation, assuming that 50% of all irrigated areas in southern European countries are at risk of salinisation, meaning around 7.15 million hectares.

According to a comparison of data from the EU wide erosion risk model PESERA (for erosion risks areas) with data from Corinne land cover (for forestry coverage), 14.8 million hectares of forest are potentially affected by erosion (>0.5 t/ha/y). To assess how much of this area is then subject to logging in an average year, the total production of roundwood from European forests in 2003 (being 368 million m^3) has been taken with an average productivity of 45 m^3/ha (for conventional logging). Consequently, around 8.2 million hectares per year are harvested, 8.2% of the total forest area. Consequently, the area to which the measure of reduced impact logging should be applied is 1.2 million ha (8.2% of 14.8 million hectares).

Corinne land cover data - corrected for those countries where no data exist - indicate around 857,500 ha construction sites in EU 25. Assuming that the measures described above should be applied in areas with erosion risks of more than 2 t/ha/y

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124 The rasters of the two databases were reclassified into a small number of classes and overlaid with each other, in order to determine for each 1x1 km cell into which erosion risk class and which land use class it falls; in this way a cross-table of land use and erosion risk could be prepared for each Member State.

125 Jones, R.J.A., Hiederer, R., Rusco, E., Loveland, P.J. & Montanarella, L. (2003). Topsoil organic carbon in Europe. Proceedings of the 4th European Congress on Regional Geoscientific Cartography and Information Systems, 17-20 June 2003, Bologna, Emilia Romagna, Direzione Generale Ambiente e Difesa del Suolo e della Costa, Servizio Geologico, Sismico e dei Suoli, p.249-251.

126 *Iibidem*.

(12.7% according to PESERA), a total of 11,000 hectares should consequently be subjected to specific measures to combat erosion on construction sites.

Table 14 summarises the results for all 7 packages, comparing the areas where the package should be applied to the area at risks from the particular threat in the EU-25.

***Table 14*: Areas to be covered by the different packages**

	package	*Area to be covered in EU 25 by the packages (million ha)*	*Total area at risk (EU-25, m ha, excluding Sweden, Finland, Cyprus & Malta)*
1	farming: serious erosion (>10 t/ha/y)	8.1	10.1
2	farming: moderate to serious erosion (2-10 t/ha/y)	22.7	27.3
3	farming: SOM loss (soil organic carbon <2%)	30.5	35.0[127]
4	farming: compaction	40.4[128]	124.1
5	farming: salinisation	7.15	14.3[129]
6	forestry (>0.5 t/ha/y erosion risk)	1.2	75.1
7	construction (>2 t/ha/y erosion risk)	0.011	37.4

The calculation of the total costs of the seven packages based on cost per package and hectares were the package could be applied is illustrated in Table 15

***Table 15*: Total costs for the eight packages per year for EU25**

Package	***Practices***	***Threat at which it is aimed***	***Cost per ha per year for package (€)***	***Risk area (m ha)***	***Total cost of package per year (million €, rounded figures)***
Serious erosion (>10 t/ha/yr)	conversion of arable land into forest or into pasture terracing buffer strips residue management cover crop	erosion, SOM loss, compaction	293	8.1	2,400

[127] The area known to be at risk is here slightly higher than the area to which the package applies. This is because of the missing data from four countries – which in the case of Sweden and Finland cover large areas. For estimating the areas of the packages, appropriate corrections have been applied for these missing data.

[128] It has been assumed that arable land has the same probability than other land to be susceptible to compaction.

[129] Irrigated area in Southern Europe.

	conservation tillage				
Moderate to serious erosion (2-10 t/ha/yr)	buffer strips residue management cover crop conservation tillage	erosion, SOM loss, compaction	139	22.7	3,200
SOM loss only	residue management cover crop conservation tillage application of EOM	SOM loss, compaction	116	30.5	3,600
Anti-compaction measures	low-pressure tyres	compaction	4.5	40.4	200
Anti-salinisation measures	drip irrigation	salinisation	604	7.15	4,300
Soil protection in forests	reduced-impact logging	erosion, SOM loss, compaction	450	1.2	500
Soil protection on construction sites	safe storm water disposal, sediment trapping, seeding, stabilised entrance	erosion	22,159	0.011	200

2.8. Benefits

2.8.1. Erosion on farmland

On-site benefits

There is no sufficient data on on-site benefits of the measures to combat erosion. Nevertheless, it has been assumed that the measures will increase productivity by 1.5% per year. At an average agricultural production on crop-land of €1,100/ha (Eurostat for 2004), this would come to an avoided loss of agricultural production to the value of €500 million in the area affected. This benefit will be cumulative. Cumulating the benefits for 20 years and subsequently discounting them[130], produces a present value of the total benefits per year of €3,250 million for EU 25.

Off-site benefits

130 This method discounts future benefits by 4% per year, then calculates the average of the discounted values. The values themselves are the cumulative productivity gains of 20 years' worth of erosion control.

These benefits arise for some economic operators which will not suffer the off-site consequences of erosion. It has been assumed that the measures applied to all surface of land suffering from 2 tons soil loss/year ha will reduce the costs of dredging and disposal of sediments, treatment of water and damage to infrastructure by 85%. Therefore the off-site benefits are 85% x €6,700 million per year (intermediate value of Table 1) that is €5,800 million per year.

2.8.2. *Loss of soil organic matter on farmland*

On-site benefits

There is no sufficient data on on-site benefits of the measures to combat organic matter decline. Nevertheless, it has been assumed that the measures will increase productivity by 1%. At an average agricultural production on crop-land of €1,100/ha (Eurostat for 2004), this would come to an avoided loss of agricultural production to the value of €319 million in the area affected. This benefit will be cumulative, as was the case in the previous section. Cumulating the benefits for 20 years and subsequently discounting them, produces a present value of the total benefits per year of €2,057 million.

Off-site benefits

It has been assumed that the measures would at least avoid the loss of 0.2% organic carbon per year so that the costs of the emissions of CO_2 from the soil would be cut by 80% per year, that is 80% x € 3,600 million (see section 2.2), that is €2,800 million per year.

2.8.3. *Compaction*

On-site benefits

For compaction, it has been assumed that the use of low-pressure tyres will increase productivity by 1% per year. At an average agricultural production on crop-land of €1,100/ha (Eurostat for 2004), this would come to a value of €444 million in susceptible arable land. Thus, the cumulative and discounted (over a 4-year period) benefit per year will be €1,027million.

Off-site benefits

They could not be established.

2.8.4. *Salinisation*

On-site benefits

The benefits of the measure, replacing the current irrigation system with drip irrigation, would come in various forms: (a) increase yield; (b) reduced water requirements, due to the higher efficiency irrigation; (c) energy savings and (d) drip irrigation permits the production of more valuable crops.

It has been assumed an increase in yield of 20% under slight salinisation (€145/ha), to 65% under moderate salinisation (€360/ha) of low value crops. However, drip irrigation leads not only to higher potential yield, but also to cost savings as less water is needed, and operating costs of drip irrigation are lower than those of surface irrigation. The former effect is difficult to measure. The latter effect, at a consumption of 2,000 m^3/ha and a price of €0.13/m^3 would mean a saving of €1,858 million for the salinised area. The total on-site benefits would be €2,900 million per year for salinised areas.

Off-site benefits

These benefits could not be quantified as no information was available.

2.8.5. Forestry

On-site benefits

The on-site benefits of reduced-impact logging to the forestry sector itself consist of higher future production of trees because of better soils. There is little data available, hence the following assumptions were made. Total production of roundwood from European forests in 2003 was 368 million m^3, or an average of 3.7 m^3 per hectare per year. If it is assumed that the productivity of soils under reduced-impact logging rises by 10% the increase of 0.37 m^3/ha would, at a price of €40/m^3, represent a benefit of €15/ha, or €18.2 million for the total area of 1,216,000 ha to which the measure would apply.

Off-site benefits

The off-site benefits from the measures in forestry to combat erosion and organic matter decline have been estimated following a very similar approach as for the agricultural measures. In this case, the total off-site benefit of the forestry measures have been estimated at €300-900 million per year, that is in average €600 million per year.

3. COMPARING THE COSTS AND BENEFITS OF THE SCENARIO; NET COSTS AND ADDITIONAL COSTS

3.1. Cost-benefit balance

Comparing the costs and benefits of these possible measures to address soil threats is very difficult as it depends strongly on the measures taken in reality by Member States. Hence this comparison could only be done in an illustrative manner in this Impact Assessment by establishing 7 packages of possible measures to address these 5 soil threats. For instance two packages were created to combat different levels of erosion in agriculture. However, in reality, the level of ambition with which erosion will be tackled will depend on the Member States and this will determine the real costs and the benefits.

It has to be kept in mind that in establishing a costs-benefit analysis:

- due to the lack of coherent and comparable data, several assumptions were necessary in which a very prudent and careful approach was taken;

- only benefits which can be monetised have been included in the table. Non quantifiable environmental and ecosystem services improvements could not be taken into account therein. However, quantifiable benefits account only for a small part of the overall benefits, so that the benefits of the measures are likely to be significantly underestimated.

Consequently, the overall results, in Table 16, reflect a "conservative" approach. The information in Table 16 builds mainly on information received from the two studies commissioned by the Commission[131,132]. In case of discrepancies, an average of the different estimates has been taken.

***Table* 16: Cost-benefit balance of a scenario for EU25 (million €/year; rounded figures)**

Column number	1	2	3	4	5	6
Package	*Total cost of possible measures envisaged in the scenario measures*	*On-site benefit for the land use of possible measures envisaged in the scenario*	*Net cost of the possible measures envisaged in the scenario (difference column 1 and 2)*	*Net benefit of the possible measures envisaged in the scenario (difference column 1 and 2)*	*Off-site benefits of possible measures envisaged in the scenario*	*BALANCE* *(column 5 – column 3 or 4)* *All Benefits*
All erosion > 2 t/ha, including measures against SOM decline	5,600	3,000	2,600		5,800	3,200
Measures against SOM decline in non-erosion risk areas	3,500	2,000	1,500		2,800	1,300
Specific anti-compaction measures	200	1,000		800	Unknown	800 + unknown off-site benefits
Level areas, salinisation	4,300	2,900	1,600		Unknown (around 600 only for infrastructure damage)	?
Soil protection in forests	500	18	500		600	100
Soil protection on construction sites	200	Unknown	200 + unknown on-site benefits		60	60 + unknown on-site benefits

131 TAUW study.
132 Ecologic study.

The figures presented in column 3 in Table 16 are the net costs of the possible measures envisaged in the scenario. They represent the net investment costs (gross investment costs minus direct profit for the investor) needed to gain the off site benefits.

The possible measures considered to combat erosion (in agriculture and forestry), organic matter decline, and compaction have clear benefits.

If Member States would take a less ambitious approach and f.i. only tackle areas with an erosion risk *higher than 10 ton of soil per ha per year*, the total costs would be about one third with an off-site benefit of about two thirds, compared to the scenario illustrated in Table 16 of 2 ton of soil/ha per year. It would still result in a relatively high overall benefit. This indicates that efficiency of the measures is highest in high risk areas. For landslides, which can be assimilated to areas of very high erosion risk, the cost benefit analysis of measures will consequently be positive.

Caveats for the cost-benefit analysis

The following caveats exist for the cost benefit analysis for erosion:

- The packages are very comprehensive (coverage higher than 200%), meaning several measures are taken simultaneously on the same field.
- Not all off-site benefits could be assessed.
- Risk areas may be smaller once better monitoring/modelling is in place.

The following caveats exist for the cost benefit analysis for **SOM decline**:

- Only climate change effects as off-site benefits has been monetised.
- The packages are very comprehensive (coverage higher than 150%), meaning several measures are taken simultaneously on the same field.
- Risk area may be smaller once better monitoring/modelling is in place.
- The calculation was done for the area with a SOM < 2%. This is an approximation only, as the area suffering from SOM decline is unknown and may be smaller, while the measure may also be needed in areas of higher SOM content to compensate for the loss of soil carbon.

With regard to measures to fight **salinisation**, the overall balance is negative, meaning that the costs would be higher than the benefits. The following aspects have to be remembered in this context:

- Investments have been calculated for 20 years, but they may last longer.

- Only moderate salinisation was taken to calculate yield loss. Combating serious salinisation with this measure will however generate much higher on-site benefits.

- It was assumed that all irrigation in risk areas would be replaced before the current equipment has been depreciated.

- The risk area may be smaller once better monitoring/modelling is in place.

- Basically no off-site costs could be calculated (except infrastructure damage), so an overall cost benefit assessment is not possible.

- The measure used to calculate the costs (new irrigation equipment) is a relatively drastic measure, less expensive measure are possible and likely to be equally used.

The following caveats exist for the cost benefit analysis for **compaction**

- No data on off-site effects are available, although less compaction will reduce erosion, flooding etc., therefore no cost/benefit assessment possible.

- The risk area may be smaller once better monitoring/modelling is in place.

The following caveats exist for the cost benefit analysis for **erosion in forestry and on construction sites**

- Forestry: The measure used to calculate the costs is a relatively comprehensive and expensive measure, other measures exist and likely to be used as well.

- Construction: Limited information is available, no off-site costs could be calculated, and it is not known what Member States (constructors) already do, and the costs (€22,000/ha seems high, but is little compared to the overall investments) are caused for a clear benefit for the constructor.

3.2. Net costs and additional costs

At present Member States already spend money to abate the net investment costs presented in column 3 in Table 16. Under cross compliance, Member States are required to set standards on soil protection, linked to direct payments and these would be applicable to all agricultural land under that regime as of 1 January 2005. It has not been possible to assess the investments derived from these new standards. In order to estimate what could be the possible additional costs emanating from new measures adopted pursuant to the Directive on soil protection, the net costs of the scenario (column 3 in Table 16) should be compared to what Member States are currently spending on a yearly basis on addressing the soil threats. This has been done for the two most widespread threats for which costs and benefits could be monetised relatively well, namely erosion and SOM decline.

It should be noted, that measures arising from river basin management plans under the Water Framework Directive, to be adopted by Member States in 2009, will allow reaping the benefits of synergies between soil and water protection measures. Since at the time these plans and measures are still not in place, they could not be included in establishing ‘what Member States already do’.

What do Member States already spend to combat erosion and SOM decline

In order to estimate current expenditure of Member States, the assessment of agri-environmental schemes of Rural Development Programmes for soil protection measures seem to be appropriate. This may provide for an underestimation of current expenditure, as Member States are also using other mechanisms (such as State Aids and cross compliance).

However, it is important to recall that standards relating to soil erosion, organic matter and structure (aimed at compaction) within cross compliance as defined by Member States have only been applicable since 2005. As these standards become more and more robust, they should deliver environmental benefits as a part of general compliance and therefore with no cost to society beyond current CAP market pillar commitments.

Soil protection is not a separate item within budgets of agri-environmental schemes, but measures therein may contribute to combat different soils threats, even if that is not their main purpose.

To produce an estimate of current expenditure on soil protection through rural development, four agri-environment programs (Portugal, Spain, Austria and the German Bundesland Saxony) have been analysed. All agri-environmental measures of the four programmes have been assessed with regard to their benefit for erosion and SOM decline. Based on that assessment, a percentage of the spending for that measure has been counted as expenditure against soil degradation (e.g. minimum tillage was counted as 100% soil measure, but organic farming as a 30% soil measure)[133]. However, this methodology is only applicable for measures against erosion and SOM decline. To extrapolate these four case studies to the entire EU, it was assumed that the percentage of the total budget allocated for measures to prevent or mitigate erosion is proportional to the magnitude of the erosion risk in that Member State (derived from PESERA). Table 17 shows the results.

[133] Actual expenditure figures for 2002 were used for Austria, national guidelines on commitments per practice for Spain, and premia for Portugal and Saxony.

***Table* 17: Percentage of agri-environmental programmes contributing to soil protection and erosion risk**

Member State or region	% of agri-environmental scheme contributing to soil protection	Average erosion risk (t/ha/y) derived from PESERA	% of agri-environmental scheme per t/ha/y of erosion risk
Austria	43.0	0.46	93.48
Saxony	27.3	1.33	20.53
Spain	58.5	2.41	24.27
Portugal	45.6	4.59	9.93
Average percentage of AE scheme allocated per ton/ha/year			37.1

Applying 37.1% as the average percentage of agri-environment scheme allocated per ton/ha/year of erosion risk and on the basis of current expenditure of all Member States on agri-environmental programmes and their respective erosion risk (PESERA) it has been estimated that €2.76 billion per year are spent on measures against erosion and SOM decline in EU25. If only Member States having more than 2 t/ha/year erosion risk are taken into account, the current expenditure on agri-environment scheme allocated to erosion measures amounts to €1,798 billion per year.

Table 18 presents the results of the comparison of the net cost of the scenario and the estimated current expenditure.

***Table* 18 Estimate of the *additional* costs of possible measures for erosion and organic matter for EU25 (M €/y; rounded figures)**

Package	**Net total cost of the scenario**	**Current expenditure by Member States on erosion and SOM-decline**	**Additional costs (compared to current expenses incurred) of the scenario**
All erosion > 2 t/ha, including measures against SOM decline	2,600	1,800	2,300
Measures against SOM decline in non-erosion risk areas	1,500		
Total	**4,100**	**1,800**	**2,300**

From this overview it should *not* be concluded that these are the additional costs to be spent by Member States in order to reach the objectives of the strategy, since again this will depend completely on the ambitions Member States will lay down in their Programmes of Measures. This overview provides rather the additional costs of this specific scenario chosen.

3.3. Conclusion: The final balance of costs and benefits of the scenario envisaged

***Table 19*: Summary of the most important costs and benefits**[134]

Annual benefits	Annual additional costs for possible measures for erosion and SOM decline taking into account what Member States already do
€8.6 billion (Derived from Table 16: €5,800 + 2,800 million) Not including substantial benefits impossible to monetise, such as improvement of soil biodiversity and soil ecosystems services	€2.3 billion

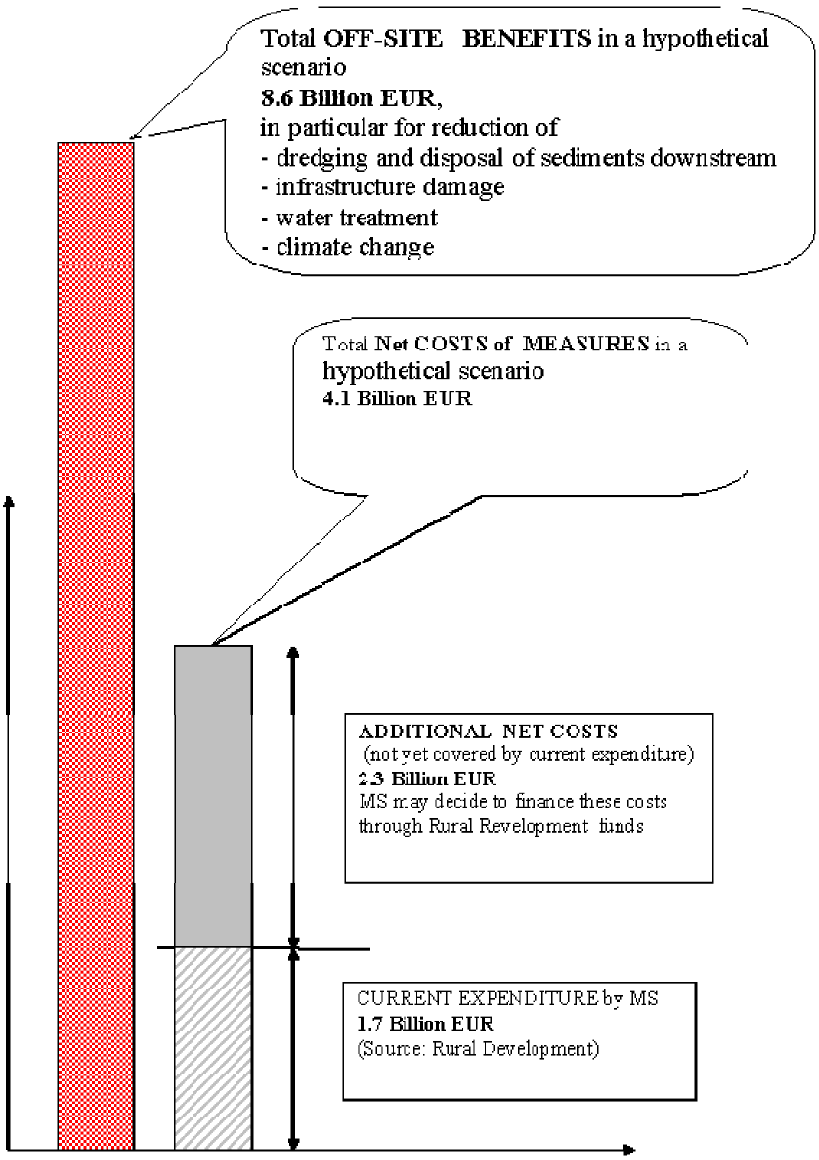
The benefits to society from the policy for erosion and organic matter are €8.6 billion per year for EU25. These benefits represent the total benefit of taking action, therefore it includes the benefits produced by additional measures adopted pursuant to the Directive but also the benefits produced by existing actions currently undertaken by Member States. It was not possible to differentiate between the benefits produced by existing measures and benefits generated by additional measures. The benefits of the additional measures will therefore be lower.

It was not possible to include in the above presented estimates the analysis of the possible overlap of other measures (e.g. Water Framework Directive, Habitats Directive, Nitrates Directive and Good Agricultural and Environmental Conditions introduced in the 2003 CAP reform).However, applying measures to combat soil threats under these programmes may lower the net costs of the Soil Framework Directive significantly.

134 Benefits represent the total benefits of taking action, including both the benefits produced by additional measures adopted pursuant to the Directive and benefits produced by existing actions currently undertaken by Member States. On the other hand, to estimate the additional costs, what has already been spent by Member States under Rural Development plans has been subtracted from the estimated total costs but the funds already spent on measures derived from the standards on cross-compliance adopted in 2005 could not be subtracted due to lack of information. Hence some of these additional costs may have already been invested. The figures of costs and benefits presented in this Table are thus not fully comparable.

The estimated additional costs of € 2.3 billion for measures to combat soil erosion and organic matter decline, refers to the additional cost of a medium level of ambition scenario. Member States will be free to choose their own level of ambition, targets and specific measures.

Figure 1: **Summary of the costs and benefits for erosion and organic matter decline**



PART 2

A scenario illustrating possible implementation of the National Remediation Strategies

The implementation of the National Remediation Strategies contains the following elements to be implemented by Member States:

- The establishment of an inventory of contaminated sites (refer to section 7.3.1 of the impact assessment).
- The actual remediation of contaminated sites, including management of remaining contamination after clean-up when appropriate.

In this part, the quantitative impacts of these elements are assessed for illustration purposes only, again by means of a scenario, as the real measures that will be taken by Member States are unknown. The costs are compared to the monetised benefits of the scenario in order to obtain its net cost or benefit.

In this scenario it is assumed that all identified contaminated sites will be remediated within a time span of 30 – 50 years.

Costs of measures already undertaken by Member States have been identified, monetised and subtracted from this balance to obtain finally the additional costs of the measures.

1. MONETISATION OF THE IMPACTS OF THE MANAGEMENT OF CONTAMINATED SITES

Not all of the impacts qualitatively assessed in chapter 8 of this Impact assessment could be quantified, mainly due to a lack of sufficient and reliable data. Quantification had to be restricted to soil quality improvement, water quality improvement, protection of biodiversity and fauna, improvement and protection of human health, improvement in land use, land value and availability of land and improvement of land use possibilities, of human health and safety, of biodiversity and of food safety as far as benefits are concerned (refer also to section 2.5: benefits are the avoided costs of contamination due to remediation) and to the remediation costs as far as costs are concerned.

The Commission is proposing a framework of measures and common objectives. The detailed implementation of the measures is left to the Member States to decide, in particular as regards the implementation a National Remediation Strategy. Nevertheless, the Commission has only for illustrative purposes made an effort to quantify the costs and benefits of the implementation of this framework by Member States, with the caveat that the Member States themselves will seek to take the most appropriate risk levels establishing both the need to remediate and the target level of remediation, the time span to carry out the remediation operation, and the most cost-effective measures to ensure an adequate management of contaminated soils. Therefore, the attempts to monetise those costs and benefits must be taken with extreme precaution due to:

- the difficulties to quantify many impacts due to the lack of data at EU level, so that only rough extrapolations can be made,
- the fact that, at this stage, the Commission cannot know how the Member States will implement the framework proposed.

1.1. Costs

The estimate of the costs due to the proposed strategy is made by multiplying the number of *potentially* contaminated sites by the average costs for site investigation and the number of contaminated sites by the average costs for remediation.

1.1.1. Estimate of the number of contaminated sites

To calculate the costs, firstly, an estimate of the potentially contaminated sites and the really contaminated sites has been established for EU25.

Table 20: Available information on the number of (potentially) contaminated sites

(Different sources on numbers: see bellow table. Blank: no information available on number of sites. Information on the total area per country from EUROSTAT statistics)

	Potentially contaminated sites (Number of sites after preliminary survey)			Contaminated sites (Number of sites where implementation of remediation activities is needed)			
	Identified by a preliminary survey	Estimated total number	Estimated number/ 1000km² total area	Identified	Estimated total number	Estimated number/ 1000km² total area	Criterion for defining a contaminated site
Austria	2.000[5]	30.000[5]	361		2.500[4]	30	Risk based[2], link to impact levels not clear
Belgium							
– Flanders		70.000-80.000[6]	5550		11.000[5]	846	Risk based, link to impact levels not clear[2]
– Wallonia							Risk based, link to impact levels not clear[2]
– Brussels							No spec. def[2].
Cyprus							
Czech Republic		4.978[5]	64		500[5]		No spec. def. [1]
Denmark	5.810[5]	30.000[4]	696				Risk based, link to impact levels not clear[2]
Estonia							No spec. def.[1]
Finland	18.000[4]	20.000[5]	66		6.500[5]	21	Risk based, link to impact levels not clear[2]
France	160.751[5]	900.000[4]	1657	3.745[5]			Risk based, link to impact levels not clear[2]

Germany	271.267[5]			12.843[5]			Risk based, link to impact levels not clear[2]
Greece							No spec. def.
Hungary	15.044[5]	30.000[5]	323		3.000[5]	32	Threshold[1]
Ireland		2.300[5]	33		200[5]	3	Risk based[5]
Italy	14.017[5]	100.000[4]	332	2.944[5]			Threshold[2]
Latvia	255[5]						No spec. def.[1]
Lithuania	5.319	15.000[4]	230	73[5]			No spec. def.[1]
Luxembourg							No spec. def.[2]
Malta		300[4]		1[5]			
Poland							Threshold
Portugal							No spec. def.
Slovakia							No spec. def[1].
Slovenia		2.692[4]	135				No spec. def[1].
Spain	15.228[5]	26.440[4]	52				Risk based, link to impact levels not clear[2]
Sweden	41.000[5]	53.000-60.000[5]	136		11.500[5]	28	Risk based[5]: -impact level 3: 1.500 impact level 2: 10.000
the Netherlands	600.000[3]	600.000[3]	17713		60.000[3]	1771	Risk based[3]: -impact level 3: 15.000 - impact level 2: 45.000
United Kingdom		100.000[7] (only England)			5 to 20% of pot. cont. sites[7]		Risk based, link to impact levels not clear[2]

Other sources:

1. the DANCE report "Management of contaminated sites and land in Central and Eastern Europe"
2. the EEA-report "Topic report No 13/1999 Management of contaminated sites in Western Europe"
3. recent Dutch inventory 2004 "Landsdekkend beeld", may 2004 and "Jaarverslag bodemsanering over 2002" RIVM for the Dutch ministry of environment(min. VROM)
4. Progress in the management of contaminated sites, EEA 2002 and Progress in the management of contaminated sites released by EEA in 2005 with data from 2003
5. recent data unofficially provided by delegates form Member States in the Common Forum to the DG Environment (June and July 2005)
6. "ontwerp milieubeleidsplan" 2003-2007 Flemish ministry
7. "Dealing with contaminated land in England, progress in 2002 with implementing the Part IIA regime" Environment Agency, September 2002

BLANK no information available on number of sites

As the table shows for many Member States there are still no estimates available of the total number of (potentially) contaminated sites. For the Member States that have made an estimate of the total number of contaminated sites there are large differences in the (estimated) numbers of (potentially) contaminated sites per

Member State both for the total number as for the total number in relation to the total area per country. There are several reasons for these differences:

- The different estimates reflect the differences in definition of contaminated sites and the differences in the environmental standards and the methods of risk assessment used to set the criteria.

- The number of contaminated sites caused by local sources is likely to be closely linked to the (historical) degree of industrialisation and the population density. There are large differences in the degree of industrialisation and population density between Member States and between the different regions within Member States.

- The (estimated) number of contaminated sites will also depend on the completeness and quality of the inventory of contaminated sites. Many Member States have started to set up an inventory but almost none have finished. There are also differences in the list of (potentially) soil polluting activities that are included in the inventory.

Because of this, the total amount of (potentially) contaminated sites could not be concluded from existing information; it had to be estimated.

The best information available to build such an estimate upon are the population per country and the area of artificial surfaces (A.S. = land cover classes 11 “Urban fabric”, 12 “Industrial, commercial and transport units” and 13 “Mine, dump and construction sites” of the Corine database).

- In table 21 the most recent estimate of the numbers of (potentially) contaminated sites per country are presented in relation to the population of the countries. The weighed average number of (potentially) contaminated sites for these 14 countries is used to make an extrapolation of the total number of (potentially) contaminated sites in the EU 25.

- In table 22 the most recent estimate of the numbers of (potentially) contaminated sites per country are presented in relation to the area of artificial surfaces. The weighed average number of (potentially) contaminated sites for these 14 countries is used to make an extrapolation of the total number of (potentially) contaminated sites in the EU 25.

Table 21: Extrapolation of the number of (potentially) contaminated sites in the EU 25, based upon total POPULATION using the estimates of 14 countries

	Population (thousands inhabitants)[1]	Estimated total number of potentially contaminated sites (number/1,000inh)	Estimated total number of contaminated sites (number/1,000inh)
Austria	8,114	3.7	0.3
Belgium Flanders	5,900	12.7	1.9
Czech Republic	10,212	0.5	0.05
Denmark	5,398	5.6	-
Finland	5,220	3.8	1.3
France	61,685	14.6	-
Hungary	10,117	3.0	0.3
Italy	57,888	1.7	-
Ireland	4,028	0.6	0.05
Lithuania	3,446	4.4	-
Slovenia	1,996	1.3	-
Spain	42,345	0.6	-
Sweden	8,976	6.3	1.3
the Netherlands	16,258	37	3.7
Total	*Total population:* 14 countries: 241,582 8 countries: 68,825	*Total number of sites* *for 14 EU countries* 1,890,000	*Total number of sites* *for 8 EU countries* 95,000
		Weighed average for 14 countries 8 sites/1,000inh	Weighed average for 8 countries 1.4 sites/1,000inh
Extrapolation for EU 25	*Total population EU 25* 458,599	*Total number of potentially contaminated sites for EU 25* 3,600,000	*Total number of contaminated sites for EU 25* 630,000

[1)] Portrait of the European Union, Eurostat 2004, population for Flanders based on “Expenditures on remediation of contaminated sites; EEA 2002”

***Table* 22: Extrapolation of the number of (potentially) contaminated sites in the EU 25, based upon the area of ARTIFICIAL SURFACES and using the estimates of 14 countries**

	Artificial surfaces[1] (1,000 km^2)	Estimated number of potentially contaminated sites (number/1,000 km^2 A.S.)	Estimated number of contaminated sites (number/1,000 km^2 A.S.)
Austria	1.5	20,000	1,667
Belgium Flanders	3 (est)	25,000	3,667
Czech republic	4.2	1,185	119
Denmark	2.4	12,500	
Finland	2.4	8,333	2,708
France	20	45,000	
Ireland	0.7	3,286	286
Hungary	5.1	5,882	588
Italy	12	8,333	
Lithuania	2.0	7,500	
Slovenia	0.5	5,384	
Spain	6.7	3,946	
Sweden	5.2	10,865	2,211
the Netherlands	3.3	181,181	18,181
Total	*Total artificial surfaces* 14 countries: 69 8 countries : 25	*Total number of sites for 14 EU countries* 1,890,000	*Total number of sites for 8 EU countries* 95,000
		Weighed average for 14 countries 27,400 sites/1000 km^2 A.S.	Weighed average for 8 countries 3,800 sites/1000 km^2 A.S.
Extrapolation for Total EU 25	*Total artificial surfaces EU 25 (1000 km2)* 119.3	*Total number of potentially contaminated sites for EU 25* 3,250,000	*Total number of contaminated sites for EU 25* 450,000

1) Based on Corine 2000 and for Sweden the most recent land use data from Eurostat, artificial surface for Belgium Flanders is estimated.

The number of potentially contaminated sites identified for EU25 is estimated to be 3,250,000 to 3,600,000 sites.

The number of really contaminated sites (where a risk for human health or the environment exists) was estimated to be 450,000 to 630,000 sites for EU25.

It should be noted that this extrapolation is based on average numbers and therefore should be used with caution because of the large differences in the number of sites per country. These differences can partly be explained by the differences in population and the area of artificial surfaces between the different countries however the most likely explanation is that these differences are caused by differences in the quality and completeness of the inventory and by differences in the definitions and environmental standards that are used by the Member States.

1.1.2. Additional costs for the inventory of contaminated sites

Not all steps of the identification process (preliminary site investigation up to feasibility study) are needed for all potentially contaminated sites.

As a first step, a preliminary survey to find the location of potentially polluting activities will be needed.

The second step, a preliminary site investigation to determine the concentration levels of contaminants will be needed.

For some of sites, after a certain number of preliminary steps, the conclusion may be that no further investigation is necessary. It has been assumed that:

- all potentially contaminated sites will need a preliminary site investigation to assess whether or not the concentration levels of dangerous substances are such that there may be sufficient reasons to believe that they pose a significant risk to human health or the environment and that every site where this appears to be the case needs a main site investigation including an on site risk assessment.

- only 40 to 55% of the sites having undergone a preliminary investigation will need the extra step of main site investigation (including on-site risk assessment)

Table 23 includes the estimated total costs of the different steps of the process to identify contaminated sites. Estimates of the additional costs for site investigations, due to the proposed soil framework directive, was made by taking the estimated total costs of identification and subsequently subtract:

- The costs for the sites that have already been investigated.

- Current and already envisaged (regardless of the Strategy) expenditure by Member States on investigations.

Table 23: **Estimate of the total additional costs for the site investigation process for EU25**

a) Total cost of site-investigation			
Step of the site investigation process	Number of sites where the step is needed	Costs per site	Average total costs
Preliminary site investigation	3,250,000 to 3,600,000 (number of potentially contaminated sites)	€1,300 to 4,900 Average €3,100	€11 billion
Main site investigation	1,300,000 to 2,000,000 (40 to 55% of 3,250,000 to 3,600,000)	€ 5,200 to 19,600 Average €12,400	€20 billion
Total: 31 billion			
b) Total cost for the sites that are already identified			
33% of the total have already been identified: €10 billion already incurred	In 12 countries about 1.15 million potentially contaminated sites have been identified by a preliminary survey, which is about 33% of the estimated total number of *potentially* contaminated sites for the EU 25 (3.5 million sites)		
c) Current expenditures of 12 Member States on site investigation			
€15 billion	12 countries spent in total about €3 billion per year on investigation and remediation of contaminated sites. Most of these countries have a time frame of around 25 years to complete their programmes. This means that over this period a total of €75 billion will be spent on site investigation and remediation, regardless of this strategy. The assumption is made that these expenditures are divided in investigation (20%) and remediation (80%) of sites.(see also table 25)		
€6 billion	Total additional costs (a-b-c) for EU25		
Total annual additional costs for EU 25costs			
240 million per year for EU25	Given a maximum time span of 25 years to complete the inventory of contaminated sites		

Given that the Inventory of contaminated sites may take a time span up to 25 years, the additional annual costs if the inventory accrues to €240 million per year for EU25.

It should be noted that these costs will not be evenly distributed among Member States as some are already fairly advanced in their inventory, others will have to make bigger efforts. It should furthermore be noted that these costs are likely to be an upper bound estimate:

- The estimated number of (potentially) contaminated sites used to calculate the costs is likely to be high as compared to other estimates.

- Costs are based on the assumption that every site that appears on the list of potentially contaminated sites needs preliminary site investigations Over time however, with accrued experience, expert judgement, more efficient ways of carrying out the investigation (e.g. by clustering them) and the development of alternative investigation techniques (e.g. remote sensing) risks are likely to be assessed alternatively[135], hence the costs of the inventory of contaminated sites[136] can be expected to be much lower.

Based on the current share of costs, and not withstanding developments coming from the Community liability regime, these costs would be mainly borne by public administrations. The soil status report therefore was introduced (see section 7.4 of the impact assessment) as an instrument to provide, *inter alia*, for private funding of a certain part of these costs.

1.1.3. The total costs of soil remediation

Based on the figures presented in section 1.1.2, it is assumed that on 25 to 45% of the sites where a main site investigation has been carried out, remediation will be needed (including a feasibility study).

The total costs for the remediation of contaminated sites are estimated in Table 24 by multiplying the remediation costs per site with the estimated number of contaminated sites. To take account of the difference in remediation costs, a distinction has been made between small-scale and large-scale sites.

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135 In the Netherlands for instance, originally more than 100,000 sites on a total of more than 725,000 were on the list of potentially contaminated sites because of the presence of domestic fuel tanks (Ministerie van VROM (2005) Evaluatie Bodemsanering: Analyse landsdekkend beeld). Since these sites appear hardly to be contaminated, it is considered to be inefficient to investigate the remaining sites and to redirect site investigation budgets to sites that are likely to be seriously contaminated. Instead, these sites are classified as probably not (seriously) polluted sites. To be on the safe side, however, these sites remain flagged in the information system to alert any owner or prospective buyer that there may be a problem concerning soil contamination.

136 In the Dutch example, from the originally circa 425,000 potentially contaminated sites, it is expected that after preliminary survey, 'only' about 15% or 60,000 sites will need site investigation and subsequent remediation (see figure 21 in the Dutch report referred to in the previous footnote).

Table 24: Estimate of the total soil and groundwater remediation of contaminated sites for EU25

	Number of sites	Costs per site	Average total costs
Feasibility study and remediation investigation	25 to 45% of 1,300,000 to 2,000,000 sites where main site investigation took place (Table 23) 325,000 to 900,000	€ 19,500 to 73,500	€28 billion
Small scale sites (86% of the total number of sites)	86% x (450,000 to 630,000 contaminated sites) 387,000-541,800	€ 85,000 to 160,000	€57 billion
Large scale sites (14% of the total number of sites)	14% x (450,000 to 630,000 contaminated sites) 63,000-88,200 sites	€400,000 to 500,000	€34 billion
TOTAL			€119 billion

ESTIMATED CLEAN UP COSTS IN THE US[137]

In order to have a reference, it would be important to keep in mind that the US EPA has estimated the cleanup costs for the USA to be $170- 250 billion (average $209 billion) for an estimated number of 235,000- 355,000 sites (average 294,000) which will need clean up.

Also in the case of the US, most of these costs will be borne by the owners of the properties (private and public entities) and those responsible for the contamination.

The time span for their estimates and their planning for the cleanup is 30 years. Estimates beyond 30 years are not provided in the report, although it is indicated that there are probably several hundreds of thousands additional potentially contaminated sites that have not been identified yet.

137 Cleaning Up the Nation's Waste Sites: Markets and Technology Trends - 2004 Edition. EPA report http://www.epa.gov/tio/download/market/2004market.pdf.

1.1.4. *The additional costs of soil remediation due to the implementation of the National Remediation Strategies*

Due to the fact that in all estimates found in literature for the remediation of contaminated sites, included also the costs of remediation groundwater , these extrapolations also include the costs of both soil and groundwater remediation.

An estimate of the additional costs for the management of contaminated soil due to the proposed strategy was done (see Table 25) by taking the above estimated total costs of the management of contaminated soil and subtract the following:

- The costs for the sites that have already been remediated and investigated.
- Current and already envisaged (regardless of the Strategy) expenditure by Member States on investigations and remediation
- The costs for the remediation of groundwater, since these costs are not derived from the soil Thematic Strategy but from the Water Framework Directive[138].

***Table* 25: Additional costs of the management of contaminated soil in EU25[139] for all historical contamination**

a) Total cost for the integrated approach of soil and groundwater contamination	
€119 billion	(from table 24)
b) Total cost for the sites that are already remediated	
6% of the total have already been remediated: €7 billion already incurred	In 14 countries about 28,000 contaminated sites have already been remediated or a remediation is under progress, which is about 6% of the estimated total number of contaminated sites (0.5 million sites) It is assumed that the number of sites contaminated by diffuse sources that will have to be remediated is very low.
c) Current expenditures of 12 Member States on remediation and investigation	
€60 billion	12 countries spent in total about €3 billion per year on investigation and remediation of contaminated sites. Most of these countries have a time frame of around 25 years to complete their programmes. This means that over this period a total of €75 billion will be spent on site investigation and remediation, regardless of this strategy. The assumption is made that these expenditures are divided in investigation (20%) and remediation (80%) of sites (see also table 23).

138 The costs found in the literature for the remediation of contaminated sites covered in almost all cases the remediation of both soil and groundwater. Groundwater remediation constitutes a very big share of the costs. Nevertheless the obligation to remediate groundwater does not emanate from this proposal but from the Water Framework Directive; hence these costs have been subtracted. On the other hand, as regards the inventory, this distinction between costs of soil and groundwater is not applicable.

139 TAUW study.

Subtotal (a-b-c)	
€52 billion	
d) Costs for the remediation of GROUNDWATER not derived from the strategy	
62% of €52 billion: €32 billion	For small and medium size sites, approximately 38% of the costs are spent on soil remediation and 62% is spent on groundwater remediation. For large scale sites and mega sites the percentage of the costs spent on groundwater remediation will be higher.
Total (a-b-c-d)	
€20 billion	Rough estimate of the ADDITIONAL TOTAL costs stemming from the Soil Thematic Strategy to manage all contaminated sites in EU25, including feasibility studies

Assuming that the remediation of all historically contaminated sites will take a period of 30 to 50 years, the additional annual costs vary from € 0.4 billion per year, if Member States clean up all sites in a 50 year period (20/50), to € 0.67 billion per year for a 30 year period (20/30).

Based on the current share of costs, and not withstanding developments coming from the Community liability regime, it can be estimated that public funding would cover half of these extra costs, whereas private funding will cover the other half.

1.2. Additional benefits

As seen in section 2.6 of the Impact Assessment, the benefits of managing contaminated sites can be classified into five different categories:

- soil quality improvement;

- water quality improvement;

- protection of biodiversity and fauna;

- improvement and protection of human health;

- improvement in land use, land value and availability of land.

It is very difficult to quantify and monetise each one of these categories of benefits.

The Ecologic study estimated the total annual costs generated by soil contamination. Assuming that historical contamination is a finite problem, which implies that preventive measures imposed through air legislation, waste legislation, product legislation, etc; preclude new contamination from occurring, managing historical contaminated sites will save the costs which are now been incurred into. Therefore the costs of soil contamination are taken as the potential benefits if the problem is solved. Hence the benefits are seen as avoided costs. That is up to annually €17.3 billion for EU25 (see section 2.6 and Table 4 of the impact assessment). These are regarded the total benefits of the remediation of all contaminated sites.

However, as was shown in Table 25, a significant part of soil contamination will be carried out by Member States regardless of the Soil Thematic Strategy. Hence existing and already planed actions from Member States will be yielding some benefits. In order to attempt to assess the additional benefits that will arise from the Soil Thematic Strategy a similar argument is used as to calculate the additional costs. Table 25 shows that about €45 billion would be needed to address the soil contamination (not counting groundwater contamination). Out of this amount, some €25 billion has already been spent or is expected to be spent under existing MS programmes, leaving the additional costs of soil remediation in this area at about €20 billion. It is assumed that the additional benefits of soil remediation might be distributed in approximately similar proportions that is, about 25/45 of the annual benefits could be estimated to be due to existing MS programmes, and about 20/45 to come from the Soil Thematic Strategy. Therefore, this would mean that the additional annual benefits in the long term amount to about (17.3*20/45) €7.7 billion for EU 25.

2. CONCLUSION: COMPARING COSTS AND BENEFITS OF POSSIBLE MEASURES ENVISAGED IN THE SCENARIOS TO IMPLEMENT THE NATIONAL REMEDIATION STRATEGY

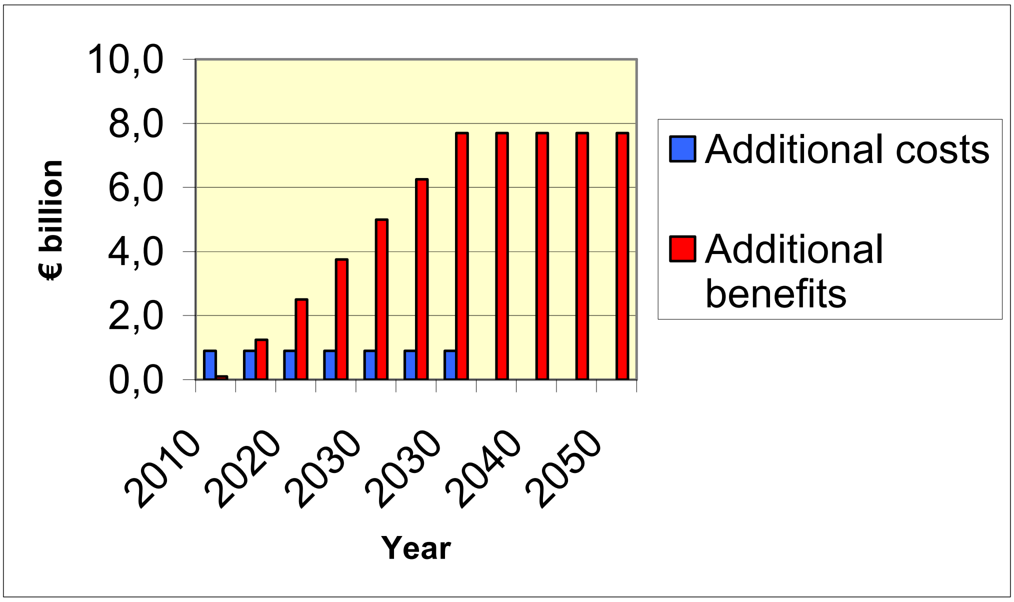
In Table 26 the most important additional costs and benefits are summarised for the supposed management of the contaminated sites in EU25.

***Table 26*: Summary of the costs and benefits for the management of contaminated sites in the scenario envisaged**

Annual additional benefits	Annual additional costs taking into account what Member States already do
Up to €7.7 billion Not including substantial benefits impossible to monetise, such as: • Improvement of soil quality, soil biodiversity and ecosystems services • Contribution to more rational land use as remediated sites improve land use possibilities • Creation of a level playing field	Management of contaminated sites: If MS clean up in • 30 years: €0.67 billion per year • 50 years: €0.4 billion per year

It should be noted that these additional annual benefits will not be reaped immediately after starting the remediation of contaminated sites. It can reasonably be assumed that, on average, each year's spending should lead to the remediation of an approximately equal amount of contamination, and consequently, to an approximately equal share of the benefits. On this basis, if Member States take 30 years to complete their programmes, they will spend about €0.9 billion per year (€0.24 billion on investigation – see section 7.3 and table 7 of the impact assessment - and €0.67 billion on remediation) to produce a permanent annual flow of benefits of about €7.7/30 = €0.25 billion per year; that is, each year's spending generates its own flow of benefits. Benefits have a cumulative effect. Assuming that these benefits occur immediately upon remediation, then annual benefits from a given year's spending outweigh the annual costs after about 4 years (see Figure 2). Hence, benefits clearly exceed costs.

***Figure 2*: Remediation of contaminated sites - illustration of trends and order of magnitude in costs and benefits, under a timeframe of 30 years**



Overall the additional costs are clearly compensated by the additional benefits for which some form of monetisation could be made. Taking into account the substantial benefits of improving the soil ecosystem serviced and biodiversity, which could not be quantified, it seems that the total benefits of the management of contaminated sites far outweigh the additional costs. This can be illustrated by the fact that the financial impact of the proposals will bring up the level of expenditure in the 13 countries of EU25 that have not yet started with the management of contaminated sites to the same level as the 12 countries that have already started.

In interpreting these figures it is important to note that:

- Costs will arise before the benefits can be achieved.

- Costs will decrease - as historical soil contamination will disappear or at least will be controlled, benefits will increase with time as soil fertility and soil functions are restored.

- The degree to which benefits can eventually be reaped depends on the level of ambition that will be chosen by MS. That means that the additional benefits will only reach the level of the estimated €7.7 billion per year if all contaminated sites are remediated due to the Soil Thematic Strategy.

Annex 2 -Results of the Internet Consultation

Thematic Strategy on Soil Protection - Citizens

Status : Closed
Date open : 2005-07-28
End date : 2005-09-26
1206 responses

Your profile

Which is your country of residence?

		% of total
FR - France	515	(42.7%)
ES - Spain	178	(14.8%)
DE - Germany	160	(13.3%)
BE - Belgium	61	(5.1%)
UK - United Kingdom	55	(4.6%)
PT - Portugal	47	(3.9%)
NL - Netherlands	45	(3.7%)
IT - Italy	29	(2.4%)
AT - Austria	21	(1.7%)
PL - Poland	16	(1.3%)
FI - Finland	11	(0.9%)
IE - Ireland	8	(0.7%)
OTHER	8	(0.7%)
MT - Malta	7	(0.6%)
DK - Denmark	5	(0.4%)
EE - Estonia	5	(0.4%)
HU - Hungary	5	(0.4%)
SE - Sweden	5	(0.4%)
EL - Greece	4	(0.3%)
LU - Luxembourg	4	(0.3%)
SI - Slovenia	4	(0.3%)
CH - Switzerland	3	(0.2%)
TR - Turkey	3	(0.2%)
CZ - Czech Republic	2	(0.2%)
CY - Cyprus	1	(0.1%)
LV - Latvia	1	(0.1%)
SK - Slovak Republic	1	(0.1%)
IS - Iceland	1	(0.1%)
NO - Norway	1	(0.1%)
LT - Lithuania		(%)
LI - Liechtenstein		(%)
BG - Bulgaria		(%)
RO – Romania		(%)

Gender

		% of total
Male	676	(56.1%)
Female	529	(43.9%)

Age range		
		% of total
25-44	690	(57.2%)
45-64	299	(24.8%)
18-24	115	(9.5%)
+ 64	101	(8.4%)

General questions on soil

Do you consider yourself well informed about the importance of soil and soil functions for human activities and the survival of ecosystems?		
		% of total
I am confident I know sufficient	561	(46.5%)
I know the basics	416	(34.5%)
I know very little	229	(19%)

Almost all human activities are based on soil. In which of the following areas are you aware that soil plays a crucial role in: (Tick as many as applicable)		
		% of total
maintaining good quality of surface water, groundwater and drinking water	1142	(94.7%)
hosting many organisms which are important for the ecosystems	1100	(91.2%)
providing agricultural products, timber and biomass	1095	(90.8%)
providing the basis of different landscapes (e.g. protected areas)	813	(67.4%)
preserving traces about past civilisations and geological eras	652	(54.1%)
providing minerals, clay, sand, aggregates, peat or other raw materials	638	(52.9%)

In your opinion, which of the following activities contributes most to soil degradation? (Tick a maximum of 5 options)		
		% of total
polluting industrial installations	847	(70.2%)
overuse of pesticides	757	(62.8%)
intensive arable farming	680	(56.4%)
urban sprawl	609	(50.5%)
illegal landfills	586	(48.6%)
clear felling	462	(38.3%)
poorly managed extractive industry	444	(36.8%)
intensive livestock production	415	(34.4%)
poor irrigation practices	357	(29.6%)
heavy machinery use	255	(21.1%)
excessive machinery use	160	(13.3%)
land abandonment	118	(9.8%)
I don't know	5	(0.4%)

How would you rank the importance of preventing and mitigating soil degradation in the EU?		
		% of total
very important	818	(67.8%)
important	280	(23.2%)
important but less than other environmental problems	98	(8.1%)
not at all important	7	(0.6%)
I don't know	3	(0.2%)

Although soil type and characteristics are very variable across Europe, it is subject in many countries to the same problems. Soil is a static media, nevertheless, soil degradation has transboundary impacts. Against this background which of the following courses of action is the most appropriate?		
		% of total
a framework is developed at EU level and measures are established at national/local level	900	(74.6%)
all measures are established at EU level	198	(16.4%)
no action is taken at EU level	58	(4.8%)
I don't know	50	(4.1%)

Soil Threats

Which of these threats affecting soil do you consider to be the most important in your country? (Tick a maximum of three threats)		
		% of total
contamination	766	(63.5%)
soil biodiversity loss	601	(49.8%)
sealing	561	(46.5%)
erosion	558	(46.3%)
organic matter decline	416	(34.5%)
compaction	158	(13.1%)
salinisation	135	(11.2%)
landslides	78	(6.5%)
I don't know	39	(3.2%)

Do you think it is important to know exactly where these threats are or might be occurring in the national territory?		
		% of total
very important	716	(59.4%)
important	404	(33.5%)
medium	68	(5.6%)
low	10	(0.8%)
I don't know/No opinion	7	(0.6%)

Do you think that the identification of areas at risk from these threats is a good way to approach soil protection?		
		% of total
Yes, to know where the problem is or might be occurring	1046	(86.7%)
No, other approaches are better	95	(7.9%)
I don't know/No opinion	65	(5.4%)

Please indicate to which extent you agree with the following statement: in the identified risk areas, the Member States must adopt the necessary measures to prevent and mitigate these threats to soil		
		% of total
I agree fully	871	(72.2%)
I rather agree	293	(24.3%)
I do not agree	23	(1.9%)
I don't know	16	(1.3%)

Soil Sealing

How important do you think the problem of soil sealing is?		
		% of total
very important	680	(56.4%)
important	393	(32.6%)
medium	95	(7.9%)
I don't know	24	(2%)
low	14	(1.2%)

EROSION, COMPACTION, SALINISATION, ORGANIC MATTER AND BIODIVERSITY DECLINE, LANDSLIDES

Which of these measures, do you believe are appropriate to prevent erosion, salinisation, compaction, organic matter and biodiversity decline? (Tick as many as applicable)		
		% of total
changing agricultural and forestry land management practices (e.g. reduced tillage, crop choice and crop rotations, use of organic fertilisers, restrictions on some practices of clearfelling of timber, restricting stocking rates, improve irrigation techniques, restricting heavy machinery use)	1082	(89.7%)
preserving or adding landscape elements (e.g. terraces, buffer strips)	739	(61.3%)
changing land use (e.g. from arable land to grassland or forestry)	518	(43%)
preventing fires (e.g. regulate controlled burning)	484	(40.1%)
I don't know	37	(3.1%)

Which of these measures do you believe are the most appropriate to prevent landslides in risk areas? (Tick as many as applicable)		
		% of total
establishing, maintaining landscape elements such as terraces, hedgerows, groves	979	(81.2%)
land use restrictions (e.g. restricting constructions in some agricultural or forest land)	818	(67.8%)
codes for construction (e.g. criteria for excavation, construction, and grading)	551	(45.7%)
preventing land abandonment	276	(22.9%)
developing early warning system	234	(19.4%)
protective measure for existing constructions	208	(17.2%)
I don't know	52	(4.3%)

Contamination

A potential buyer of a parcel of land is entitled to know if a soil polluting activity took place or is taking place in the site.		
		% of total
I agree fully	1074	(89.1%)
I rather agree	118	(9.8%)
I rather disagree	6	(0.5%)
I disagree completely	4	(0.3%)
I don't know/No opinion	4	(0.3%)

If there is/has been a soil polluting activity on the site, the potential buyer of that parcel of land is entitled to have a report of the state of the soil therein (a validated report provided by the land seller)		
		% of total
I agree fully	990	(82.1%)
I rather agree	176	(14.6%)
I rather disagree	27	(2.2%)
I disagree completely	10	(0.8%)
I don't know/No opinion	3	(0.2%)

Every Member State must establish an inventory of contaminated sites in their national territory.		
		% of total
I agree fully	946	(78.4%)
I rather agree	219	(18.2%)
I rather disagree	20	(1.7%)
I disagree completely	10	(0.8%)
I don't know/No opinion	10	(0.8%)

The inventory of contaminated sites should be made available for the public to consult		
		% of total
I agree fully	942	(78.1%)
I rather agree	197	(16.3%)
I rather disagree	36	(3%)
I disagree completely	16	(1.3%)
I don't know/No opinion	14	(1.2%)

On the basis of the inventory produced, every Member State must establish a plan for the remediation of the contaminated sites identified.		
		% of total
I agree fully	866	(71.8%)
I rather agree	260	(21.6%)
I rather disagree	51	(4.2%)
I don't know/No opinion	16	(1.3%)
I disagree completely	13	(1.1%)

Private ownership of land

Land owners have a duty of care to ensure that soil is used in a sustainable manner		
		% of total
I agree fully	846	(70.1%)
I rather agree	309	(25.6%)
I rather disagree	25	(2.1%)
I don't know/No opinion	14	(1.2%)
I disagree completely	11	(0.9%)

Feedback on the questionnaire

Thank you for your co-operation. What is your opinion of this questionnaire?		
		% of total
It met my expectations	973	(80.7%)
It did not meet my expectations	172	(14.3%)

If it did not, why so?		
		% of total
too general	75	(6.2%)
content not pertinent	43	(3.6%)
too short	25	(2.1%)
too technical	9	(0.7%)
too difficult to understand	8	(0.7%)
too long	2	(0.2%)

Thematic Strategy on Soil Protection - organisations

Status : Closed
Date open : 2005-07-28
End date : 2005-09-26
662 responses

Identification

Are you replying		
		% of total
as an individual expert	377	(56.9%)
on behalf of an organisation	285	(43.1%)

Country where your organisation is based		
		% of total
DE - Germany	84	(12.7%)
FR - France	50	(7.6%)
AT - Austria	25	(3.8%)
NL - Netherlands	24	(3.6%)
UK - United Kingdom	24	(3.6%)
BE - Belgium	15	(2.3%)
HU - Hungary	10	(1.5%)
IT - Italy	9	(1.4%)
BG - Bulgaria	7	(1.1%)
FI - Finland	5	(0.8%)
PL - Poland	4	(0.6%)
SE - Sweden	4	(0.6%)
CH - Switzerland	4	(0.6%)
ES - Spain	3	(0.5%)
NO - Norway	3	(0.5%)
DK - Denmark	2	(0.3%)
CY - Cyprus	1	(0.2%)
CZ - Czech Republic	1	(0.2%)
EL - Greece	1	(0.2%)
IE - Ireland	1	(0.2%)
LT - Lithuania	1	(0.2%)
MT - Malta	1	(0.2%)
PT - Portugal	1	(0.2%)
SK - Slovak Republic	1	(0.2%)
OTHER	1	(0.2%)
EE - Estonia		(%)
LU - Luxembourg		(%)
LV - Latvia		(%)
SI - Slovenia		(%)
IS - Iceland		(%)
LI - Liechtenstein		(%)
TR - Turkey		(%)
RO – Romania		(%)

Area of activity		
		% of total
Public administration	89	(13.4%)
other, please specify	42	(6.3%)
Academic Institution (university, ...)	29	(4.4%)
Environmental NGO	26	(3.9%)
Industry	23	(3.5%)
Business Organisation	21	(3.2%)
Consultancy	21	(3.2%)
Industry of remediation of contaminated soil	13	(2%)
Farmer Organisation	11	(1.7%)
Trade association	4	(0.6%)
Trade Union	3	(0.5%)
Consumer NGO	1	(0.2%)

In line with good practice on stakeholder consultation, the Commission will publish the responses on its website, together with a summary, identifying who has said what and how the contributions will be taken into account. Would you prefer your comments to remain anonymous?		
		% of total
No	170	(25.7%)
Yes	110	(16.6%)

Was your organisation or were you, as an expert, involved in the working groups established by the Commission for the development of soil policy?		
		% of total
No	510	(77%)
Yes	150	(22.7%)

General Questions

Do you consider yourself well informed about the importance of soil and soil functions for human activities and the survival of ecosystems? (Tick only one)		
		% of total
I am sufficiently well informed	532	(80.4%)
I know the basics	109	(16.5%)
I know very little	6	(0.9%)

Almost all human activities are based on soil. Is your area of activity relying on some of these soil functions? Tick as many as applicable		
		% of total
soil contributing to the good quality of surface water, groundwater and drinking water	544	(82.2%)
soil contributing to production of agricultural goods, timber and other biomass	406	(61.3%)
soil as the habitat of many organisms which are important for the ecosystems	381	(57.6%)
soil as the basis of different landscapes of interest (e.g. protected areas)	337	(50.9%)
preservation of archaeological and geological heritage	148	(22.4%)
extraction, production of clay, sand, aggregates, peat or other raw mineral materials	130	(19.6%)

How would you rank the importance of preventing and mitigating soil degradation in the EU?		
		% of total
Very important	454	(68.6%)
Important	143	(21.6%)
important but less than other environmental problems	58	(8.8%)
not important at all	3	(0.5%)
I don't know	2	(0.3%)

Soil Threats

Which of these soil threats do you consider are most relevant to your activity?		
		% of total
contamination	481	(72.7%)
erosion	387	(58.5%)
organic matter decline	326	(49.2%)
sealing	301	(45.5%)
soil biodiversity loss	278	(42%)
compaction	245	(37%)
salinisation	98	(14.8%)
landslides	61	(9.2%)
I don't know	5	(0.8%)

With regard to these threats, for which would you think action is most needed? (tick a maximum of three)		
		% of total
contamination	456	(68.9%)
erosion	400	(60.4%)
sealing	275	(41.5%)
organic matter decline	251	(37.9%)
soil biodiversity loss	195	(29.5%)
compaction	107	(16.2%)
salinisation	68	(10.3%)
landslides	38	(5.7%)
I don't know	3	(0.5%)

Although type and characteristics are very variable across Europe, soil is subject in many countries to the same threats. Soil is a static media, nevertheless, soil degradation has transboundary impacts. Against this background, which of the following courses of action is the most appropriate?		
		% of total
a framework is developed at EU level and measures are established at national/local level	581	(87.8%)
all measures are established at EU level	38	(5.7%)
no action is taken at EU level	31	(4.7%)
I don't know	11	(1.7%)

How would you rank the importance for your activity to know where these threats are or might be occurring in the national territory?		
		% of total
Very important	316	(47.7%)
Important	239	(36.1%)
Medium	73	(11%)
Low	28	(4.2%)
I don't know	4	(0.6%)

Do you think that the identification of areas at risk of these threats is the correct way to tackle soil protection?		
		% of total
Yes, it is important to know where the problem is or might be occurring	581	(87.8%)
No, other approaches are better	63	(9.5%)
I don't know	15	(2.3%)

Sealing

How important do you think this problem is?		
		% of total
Very important	301	(45.5%)
Important	243	(36.7%)
Medium	90	(13.6%)
Low	17	(2.6%)
I don't know	8	(1.2%)

How important is it to take soil protection aspects into account in land use planning?		
		% of total
very important	421	(63.6%)
important	195	(29.5%)
medium	30	(4.5%)
low	6	(0.9%)
I don't know	6	(0.9%)

Erosion, organic matter decline, salinisation, compaction, landslides

For EROSION, which measures do you believe are appropriate? (tick as many as applicable)

		% of tota
hedgerows and groves	371	(56%)
choice of crops/crop rotations	365	(55.1%)
winter cover	357	(53.9%)
catch and interim crops	326	(49.2%)
conservation tillage	305	(46.1%)
restricting construction works on particularly vulnerable sites	291	(44%)
afforestation of agricultural and degraded land	288	(43.5%)
contour ploughing	262	(39.6%)
use of organic soil improvers/exogenous organic matter (e.g. compost)	224	(33.8%)
change of arable to grassland	222	(33.5%)
creating buffer strips	201	(30.4%)
restrictions on some practices of clearfelling of timber	199	(30.1%)
appropriate timing of ploughing	194	(29.3%)
mulching	190	(28.7%)
terraces	184	(27.8%)
restricting heavy machinery use	168	(25.4%)
restricting uncontrolled burning	165	(24.9%)
adjusting stocking rates	153	(23.1%)
adjusting duration and season of grazing	106	(16%)
appropriate site preparation techniques for afforestation	104	(15.7%)
regulating controlled burning	97	(14.7%)
growing fire resilient plant communities	49	(7.4%)
I don't know	41	(6.2%)

Would these measures (or one in particular) have a POSITIVE economic and/or social impact on your activity?

		% of tota
none	169	(25.5%)
negligible	146	(22.1%)
I don't know	123	(18.6%)
high	111	(16.8%)
medium	78	(11.8%)

Would these measures (or one in particular) have a NEGATIVE economic and/or social impact on your activity?

		% of tota
none	288	(43.5%)
negligible	160	(24.2%)
I don't know	114	(17.2%)
medium	36	(5.4%)
high	20	(3%)

For ORGANIC MATTER DECLINE and SOIL BIODIVERSITY loss, which measures do you think are appropriate? (Tick as many as applicable)		
		% of total
incorporation of crop residues	394	(59.5%)
choice of appropriate crops/crop rotations	388	(58.6%)
use of organic soil improvers/exogenous organic matter (e.g. composts)	366	(55.3%)
conservation tillage	283	(42.7%)
catch and interim crops	279	(42.1%)
hedgerows and groves.	273	(41.2%)
reduce deforestation	267	(40.3%)
change of arable to grassland	228	(34.4%)
restrict uncontrolled burning of crop residues	181	(27.3%)
increase of water table to restore cultivated peat soils	166	(25.1%)
creating buffer strips	147	(22.2%)
adjusting stocking rates	123	(18.6%)
regulate controlled burning	114	(17.2%)
I don't know	46	(6.9%)
growing of fire resilient plant communities	39	(5.9%)

Would these measures (or one in particular) have a POSITIVE economic and/or social impact on your activity?		
		% of total
none	175	(26.4%)
negligible	151	(22.8%)
I don't know	126	(19%)
high	93	(14%)
medium	79	(11.9%)

Would these measures (or one in particular) have a NEGATIVE economic and/or social impact on your activity?		
		% of total
none	291	(44%)
negligible	148	(22.4%)
I don't know	122	(18.4%)
medium	31	(4.7%)
high	15	(2.3%)

For COMPACTION, which measures do you believe are appropriate? (tick as many as applicable)		
		% of total
cultivation at optimal soil moisture	413	(62.4%)
restricting excessive heavy machinery use	409	(61.8%)
low pressure tyres	336	(50.8%)
especially designed machinery	302	(45.6%)
conservation tillage	258	(39%)
adjusting duration and season of grazing	212	(32%)
adjusting stocking rates	184	(27.8%)
drainage to improve soil strength	137	(20.7%)
change from agriculture to forestry	115	(17.4%)
deep ploughing/depth loosening	109	(16.5%)
I don't know	80	(12.1%)

Would these measures (or one in particular) have a POSITIVE economic and/or social impact on your activity?		
		% of total
none	214	(32.3%)
negligible	157	(23.7%)
I don't know	126	(19%)
medium	65	(9.8%)
high	49	(7.4%)

Would these measures (or one in particular) have a NEGATIVE economic and/or social impact on your activity?		
		% of total
none	293	(44.3%)
negligible	141	(21.3%)
I don't know	119	(18%)
medium	31	(4.7%)
high	16	(2.4%)

For SALINISATION, which measures do you believe are appropriate? (tick as many as applicable)		
		% of total
use of appropriate irrigation techniques and equipment	361	(54.5%)
use of appropriate water quality	318	(48%)
choice of crops/crop rotation.	224	(33.8%)
drainage of irrigated land	191	(28.9%)
I don't know	172	(26%)
use of organic soil improvers(e.g. compost) with predominance of humic acids	141	(21.3%)
change from arable to grassland	80	(12.1%)
Washing the soil	71	(10.7%)
use of acid fertilizers	33	(5%)

Would these measures (or one in particular) have a POSITIVE economic and/or social impact on your activity?		
		% of total
none	219	(33.1%)
I don't know	159	(24%)
negligible	134	(20.2%)
medium	40	(6%)
high	33	(5%)

Would these measures (or one in particular) have a NEGATIVE economic and/or social impact on your activity?		
		% of total
none	281	(42.4%)
I don't know	152	(23%)
negligible	119	(18%)
medium	19	(2.9%)
high	6	(0.9%)

Which of these measures, do you believe are the most appropriate to prevent LANDSLIDES in risk areas? (Tick as many as applicable)		
		% of total
establishing, maintaining landscape elements such as terraces, hedgerows, groves	477	(72.1%)
land use restrictions (e.g. restricting constructions in some agricultural or forest land)	443	(66.9%)
codes for construction (e.g. criteria for excavation, construction, and grading)	305	(46.1%)
preventing land abandonment	175	(26.4%)
protective measure for existing constructions	153	(23.1%)
developing early warning system	129	(19.5%)
I don't know	99	(15%)

Would these measures (or one in particular) have a POSITIVE economic and/or social impact on your activity?		
		% of total
none	223	(33.7%)
negligible	152	(23%)
I don't know	140	(21.1%)
medium	39	(5.9%)
high	38	(5.7%)

Would these measures (or one in particular) have a NEGATIVE economic and/or social impact on your activity?		
		% of total
none	296	(44.7%)
I don't know	130	(19.6%)
negligible	126	(19%)
medium	20	(3%)
high	8	(1.2%)

Contamination

Is your activity affected by soil contamination?		
		% of total
Yes	375	(56.6%)
No	282	(42.6%)

Is your activity considered a "potentially soil polluting activity" in your country?		
		% of total
no	495	(74.8%)
yes	93	(14%)
in my country there is no such classification	42	(6.3%)
I do not know	28	(4.2%)

In the views of your organisation, or your expert view, the definition of a contaminated site should be based on		
		% of total
risk to human health and the environment	491	(74.2%)
concentration levels for contaminants	158	(23.9%)
I don't know	10	(1.5%)

Please indicate to which extent you agree with the following statement: A potential buyer of a parcel of land is entitled to know if a soil polluting activity took place or is taking place in the site.		
		% of total
I agree fully	579	(87.5%)
I rather agree	75	(11.3%)
I disagree completely	3	(0.5%)
I rather disagree	1	(0.2%)
I don't know/No opinion	1	(0.2%)

Please indicate to which extent you agree with the following statement: If there is/has been a soil polluting activity on the site, the potential buyer of that parcel of land is entitled to have a report of the state of the soil therein		
		% of total
I agree fully	504	(76.1%)
I rather agree	134	(20.2%)
I rather disagree	13	(2%)
I don't know/No opinion	5	(0.8%)
I disagree completely	3	(0.5%)

Please indicate to which extent you agree with the following statement: Every Member State must establish an inventory of contaminated sites in their national territory.		
		% of total
I agree fully	434	(65.6%)
I rather agree	163	(24.6%)
I rather disagree	35	(5.3%)
I don't know/No opinion	14	(2.1%)
I disagree completely	12	(1.8%)

Please indicate to which extent you agree with the following statement: The inventory of contaminated sites shall be made available for the public to consult.		
		% of total
I agree fully	379	(57.3%)
I rather agree	189	(28.5%)
I rather disagree	48	(7.3%)
I disagree completely	29	(4.4%)
I don't know/No opinion	15	(2.3%)

Please indicate to which extent you agree with the following statement: On the basis of the inventory produced, every Member State must establish a plan for the remediation of the contaminated sites identified.		
		% of total
I agree fully	343	(51.8%)
I rather agree	195	(29.5%)
I rather disagree	77	(11.6%)
I disagree completely	29	(4.4%)
I don't know/No opinion	15	(2.3%)

Private ownership

Land owners must have a duty of care to ensure that soil is used in a sustainable manner		
		% of tota
I agree fully	465	(70.2%
I rather agree	162	(24.5%
I rather disagree	19	(2.9%
I disagree completely	10	(1.5%
I don't know/No opinion	4	(0.6%

Feedback on questionnaire

Thank you for your co-operation. What is your opinion of this questionnaire?		
		% of tota
it met my expectations	495	(74.8%
it did not meet my expectations	142	(21.5%

If it did not, why so?		
		% of tota
too general	94	(14.2%
content not pertinent	26	(3.9%
too short	6	(0.9%
too difficult to understand	5	(0.8%
too technical	1	(0.2%
too long	1	(0.2%