Technical report | 78

Eionet technical workshop on indicators for soil contamination

Workshop proceedings

Vienna, 18–19 January 2001

Prepared by:
Alexandra Freudenschuss, Sigbert Huber,
Martin Schamann and Martha Wepner

Project Manager:
Anna Rita Gentile
European Environment Agency

European Environment Agency

Layout: Brandenborg a/s

Legal notice

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server (http://europa.eu.int)

ISBN 92-9167-472-9

European Environment Agency
Kongens Nytorv 6
DK-1050 Copenhagen K
Tel. (45) 33 36 71 00
Fax (45) 33 36 71 99
E-mail: eea@eea.eu.int
Internet: http://www.eea.eu.int

Contents

Executive summary

The Eionet technical workshop on indicators for soil contamination was attended by 32 participants from 19 countries (15 EEA member countries plus Bulgaria, Poland, Slovak Republic and Switzerland) and representatives from the Environment DG and the Joint Research Centre of the European Commission.

This workshop was organised by the EEA with the support of the Austrian Federal Environment Agency (UBA Vienna) and took place in Vienna on 18–19 January 2001. It was addressed to the EEA national reference centres for soil and contaminated sites. The workshop was the outcome of a working group on indicators for soil contamination, established by the EEA Management Board in November 1999. The working group had the objective to carry out the activities of the European Topic Centre on Soil (ETC/S) in the interim period before a new ETC on Terrestrial Environment (ETC/TE) was established.

The main objectives of the workshop were to:

— present results of current work on soil contamination to the Eionet partners;
— discuss the development of a selection of (priority) indicators on soil contamination;
— get information on availability of national data needed to develop the selected indicators.

The workshop was organised in three main sessions.

EEA indicator-based reporting
The workshop started with a general introduction on the objectives of the EEA work on soil indicators and the progress achieved. The work plan and the continuation of the work within the new ETC/TE were also discussed.

In particular, the priorities of EEA work on soil in 2001 were presented:

— continue work on soil contamination (indicators + Eionet workshop);
— review work on soil erosion and soil sealing (2 expert workshops);
— review work on hot spots (Eionet consultation);
— fill the gap between ETC on Soil (ETC/S) and ETC/TE; and
— provide input to the work of the new ETC/TE.

UBA Vienna provided a detailed account on the progress achieved by the EEA in the development of policy-relevant indicators with the support of ETC/S.

The major conclusions of the first session were that the EEA should continue with its work on soil indicators. High priority to soil work and in particular to the work on soil contamination should be given in the definition of the terms of reference and work programme for the new ETC on Terrestrial Environment (ETC/TE). Nevertheless, the development of soil work should reflect the changed context and the broader approach chosen by the EEA in developing the work programme on soil and land-related issues, to be integrated in the wider issue of terrestrial environment.

The information derived from existing data provided the basis for developing relevant indicators and also helped identify additional data needs. Further activities may be necessary in the countries in the future to fill existing data gaps. These may include the establishment of a European soil monitoring network (EEA, 2001a,b).

The workshop proceeded with the two technical sessions on indicators for soil contamination from localised and diffuse sources. Country representatives had the opportunity to express their opinion on the relevance of the proposed indicators and provided information on the availability of national data.

Indicators for soil contamination from localised sources
From the national presentations it emerged that countries follow different approaches for data collection. All countries have set up some sort of data collection and monitoring system, but in very different ways, based on each country's own capacity.

In 1996, the EEA started collecting data on local contamination, focusing on those data that were easily available at the country level. Important improvements were achieved in the development of indicators, but further work is needed. Focus should shift from collecting data that are easily available to collecting data that serves policy needs. In this way more resources can be devoted to new monitoring activities aimed to fill data gaps.

One important step for future work could be to better show the importance of soil protection to achieve objectives and targets established in existing legislation (e.g. the water framework and the landfill directives). Making these connections more evident would provide a stronger justification to national authorities for establishing European soil data flows and improving national monitoring systems.

Only when comparable data sets are made available the development of indicators on a regular basis can be improved and an operational framework 'from national monitoring to European reporting' can be established.

The country representatives evaluated each proposed indicator in relation to its policy-relevance and feasibility (measured by data availability) for further development. Five indicators, considered very relevant and easy to develop by participants, were selected:

— soil polluting activities
— number of contaminated sites
— progress in contaminated sites management
— expenditures on remediation activities
— groundwater incidents.

Indicators for soil contamination from diffuse sources
An overview of the work done for developing indicators for diffuse soil contamination was given, showing the state of work and introducing the proposed priority indicators.

Following the feedback on the proposed indicators by the representatives of Germany, Denmark, the Netherlands and Italy, the other country representatives made short statements, reflecting the national position on the proposed indicators.

During the discussion suggestions for additional and/or alternative indicators for diffuse soil contamination were made and added to the list of proposed indicators.

In order to get a clearer picture on the priority (mainly driven by political relevance) and feasibility (mainly depending on data availability) of the indicators the representatives of each country were asked to evaluate the proposed indicators.

The indicators considered of high importance for the country representatives were the following:

— average pesticide consumption per unit area of agricultural land;
— sewage sludge application per unit area of agricultural land;
— exceedance of critical loads of heavy metal contents in soils related to different land use;
— heavy metal balance for agricultural land;
— organic carbon or humus content in top soils related to different land use;
— occurrence of key species in soils.

However, national data was easily available only for one of the indicators proposed, the pressure indicator 'Sewage sludge application per unit area of agricultural land'.

Another point stressed during the workshop was the importance of developing impact indicators, like the crop quality or forest health, since the assessment of impacts is very relevant in policy terms.

Conclusions and follow-ups
In general it can be recognised that the workshop was an important step in the development of indicators for soil contamination. The points raised during the discussion provided insights on the way Eionet can contribute to the work on soil contamination and what are the needs of the clients. In particular:

- There was a general agreement on the list of proposed indicators but the work should focus on a smaller number of indicators.

- Most of the countries declared to be able to deliver data directly on request or in 1–2 years' time at the latest for some of the indicators proposed.

- Links to the work of other ETCs should be established in order to be able to carry out more comprehensive assessments.

- There is a need to adopt a more integrated approach to soil contamination, going beyond the definition of local and diffuse contamination and showing the connections with other soil issues, such as sealing and erosion.

As a follow-up of the workshop, a consultation on data availability was launched. The results of this consultation were summarised in a report on data needs and data availability for the development of indicators on soil contamination to be published by mid-2002.

The results achieved by the working group on soil contamination provided an important input to the work of the new ETC/TE, which started operations in July 2001. It contributed to ensure continuity to EEA work on soil contamination and support to further EEA activities on soil.

The work on soil indicators is now integrated within the broader activity of development of indicators for terrestrial environment carried out with the support of the ETC/TE.

Major progress so far has been the establishment of pilot priority data flows on soil contamination in 2001 and some steps towards the integration of the new EEA countries in the indicator work.

The priority data flows on soil contamination from localised sources are partly an answer to the requests for a more systematic data collection made by the Eionet partners at this workshop. Regular annual deliveries are requested on a limited set of national data at this early stage of development.

A technical workshop on contaminated sites for Phare countries helped the process.

The next technical workshop on indicators for soil contamination is foreseen by end of May 2002 in Seville.

1. Introduction

1.1. Background

The overall objective of the European Environment Agency (EEA) is 'to provide the Community and its Member States with objective, reliable and comparable information at European level enabling them to take the requisite measures to protect the environment, to assess the results of such measures and to ensure that the public is properly informed about the state of the environment'.

EEA main tasks include:

— to report on the state, trends and outlook of Europe's environment;
— to establish, develop and make use of the European Environmental Information and Observation Network (Eionet);
— to facilitate access to data and information supplied to, maintained and emanating from EEA and Eionet, together with access to other relevant environmental information developed by other national and international sources.

The role of the EEA, as defined by its mission and mandate, is to provide policy makers and the public with quality information, and to do so through a range of products and services. The Agency works as a facilitator or bridge between member countries, EU institutions and other environmental organisations and programmes to bring together, use, make available and thereby improve the quality of information on the environment relevant at the European level for policy making and assessment.

The European Topic Centre on Soil (ETC/S) was established by the EEA in 1996 with the objective to provide and develop data and information on soil aspects, covering all EEA member countries, in order to increase the understanding of soil as a natural resource, document soil degradation processes and improve the level of reliable and comparable information about contaminated sites, thus contributing to the development of the EEA work programme.

The ETC/S operated until December 1999. A new Topic Centre on Terrestrial Environment (ETC/TE) started operations in July 2001. The ETC/TE is carrying out the work initiated by the ETCs on Soil, Land Cover and Marine and Coastal Environment (terrestrial part of coastal environment).

On the basis of the results of the first Eionet workshop on soil (EEA, 2001a,b) and a wider review of the EEA work on soil (October 1999), in the period 2000-mid 2001 the implementation of the work programme progressed through three working groups on indicators for:

— soil contamination (from local and diffuse sources);
— soil sealing; and
— soil erosion.

This workshop is one of the outcomes of the working group on soil contamination.

1.2. Workshop objectives

This workshop was organised by the EEA with the support of the Austrian Federal Environment Agency and took place in Vienna on 18–19 January 2001.

It was addressed to the EEA national reference centres for soil and contaminated sites.

Based on the results of the Eionet workshop held in Vienna in October 1999 (EEA, 2001a,b), the main objectives of this more technical workshop were to:

— present the results of current work to the Eionet partners;
— discuss the development of a selection of (priority) indicators on soil contamination;
— get information on availability of national data needed to develop the selected indicators.

The long-term objective is to establish systematic and regular data flows between the national and the European levels to serve the reporting on the conditions of Europe's soils.

Before the workshop, the country representatives received an updated proposal for a list of indicators for soil contamination

and a request to provide information on the availability of national data necessary to the development of the proposed indicators.

1.3. Development of policy-relevant indicators on soil

(Main sources: Gentile, 1999; EEA, 2001a)

The development of indicators in general and indicators on soil contamination in particular, is a core activity for the European Environment Agency (EEA). It has the main objective to provide the basis for the reporting on the state and trends of Europe's environment.

Indicators are increasingly being used at the European and national levels as tools to get across key messages to policy-makers and others interested in environmental policy developments (e.g. policy integration, sustainable development, etc.).

The EEA has chosen an indicator-based approach for its environmental reporting since it facilitates the process of transforming data into suitable information. In fact, indicators:

— can support assessment of current policy measures and the identification of future priorities;
— can provide a system of measurement and verification of countries' performance;
— can be used to link environment, social and economic dimensions of sustainable development in an easily understandable way;
— can be used to focus and prioritise monitoring and reporting activities.

Indicators are needed to inform governments and individuals about the state of the environment and the economy and how they are changing, to measure the extent to which policy objectives for sustainable development are being achieved and to help summarise and analyse the mass of detailed environmental and economic data so that relevant messages are communicated and understood by different audiences. The indicators must be defined on the basis of:

— the needs of the policy-makers who give the strategic direction on type and theme;
— scientifically sound evidence to ensure their recognition and acceptance;
— an understanding of the practical mechanics and problems in compiling credible and timely indicators.

Indicators are also a useful tool to help prioritise data collection activities and in doing so they can help to identify gaps and redundancies in current monitoring activities and statistical collection programmes.

The EEA has defined tools to support the development of indicators, including the DPSIR (driving force, pressure, state, impact and responses) assessment framework and a typology of environmental indicators, which classifies indicators into four simple groups (descriptive, performance, eco-efficiency and overall welfare indicators).

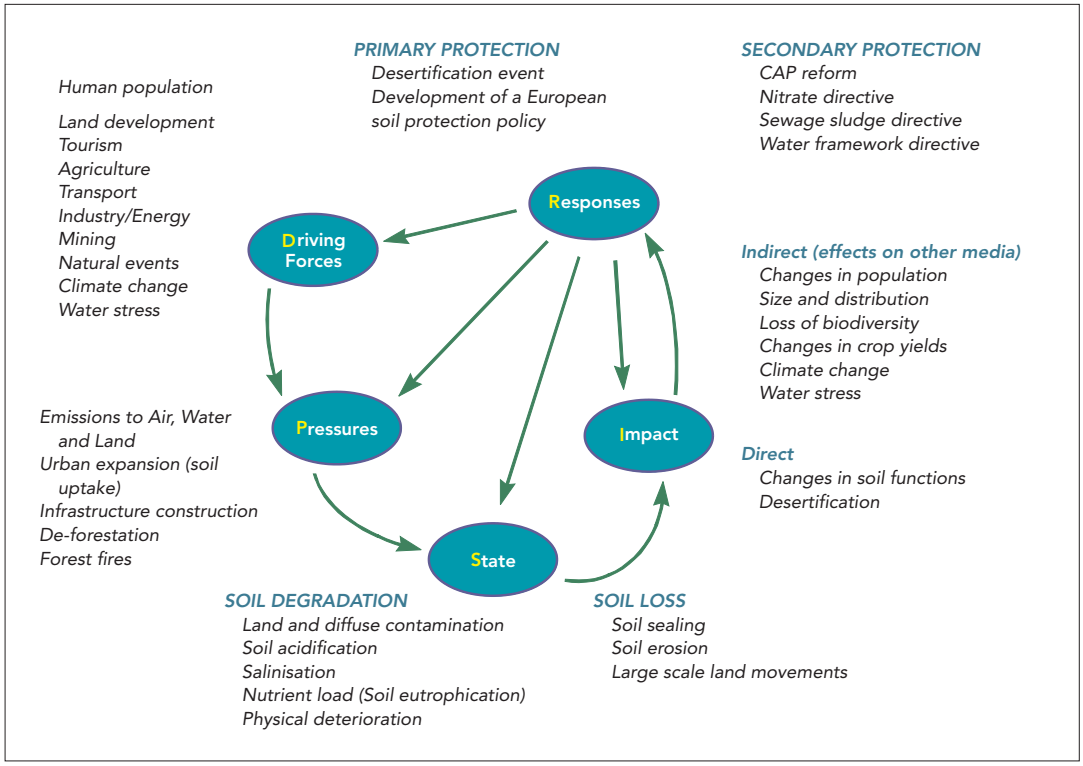
A conceptual framework for the assessment of the condition of soils and its multiple effects on the environment has been presented in the report 'Environment in the European Union at the turn of the century' (EEA, 1999). This includes the DPSIR framework applied to soil and the multi-function and multi-impact approach, based on the recognition of the role played by the soil multiple functions (ecological and socioeconomical) and the problems arising from the competition between these functions. These assessment tools represent the basis for a quantitative assessment of the condition of soils.

In order to implement these concepts, the EEA together with its Eionet partners is building an operational framework ('from national monitoring to European reporting'). The purpose of this framework is to provide policy-relevant information on soil, making use of existing activities and capabilities within member countries, including monitoring, data collection and storage (EEA, 2001a,b).

The EEA work on soil indicators and the development of the framework started in 1996 with work on indicators on contaminated sites and continued with the preparation of a tentative list of policy-relevant indicators, the assessment of data needs and data gaps and the development of a restrict number of indicators on local contamination, soil erosion and soil sealing.

Results of this work have been published in EEA reports (EEA, 1999; EEA, 2000; EEA, 2001c).

DPSIR framework applied to soil Figure 1



Source: EEA

The EEA, with the support of the ETC on Soil, organised a workshop in Vienna from 12–14 October 1999, where a proposal for a common framework for the assessment and monitoring of soil in Europe was presented. The scope of the workshop was to get to a common understanding and to agree on the way to proceed towards the implementation of the framework.

The proposal contained an initial list of policy-relevant indicators on soil to be used in EEA reporting and to support the development of soil protection policies. Furthermore, it identified a basic set of soil data that are needed to feed these indicators and that should be considered for soil monitoring at the European level. The initial list of indicators was further developed for local contamination. At the EEA technical workshop on contaminated sites, held in Dublin in November 1999, a draft hierarchical list for local contamination was presented and discussed. Three indicators of the list were selected and included in the 2001 issue of the regular indicator-based report, Environmental Signals 2001 (EEA, 2001c) Figure 2 shows the process devised for the development of soil indicators.

In order to implement these concepts, the EEA together with its Eionet partners is building an operational framework ('from national monitoring to European reporting'). The purpose of this framework is to provide policy-relevant information on soil, making use of existing activities and capabilities within member countries, including monitoring, data collection and storage (EEA, 2001a,b).

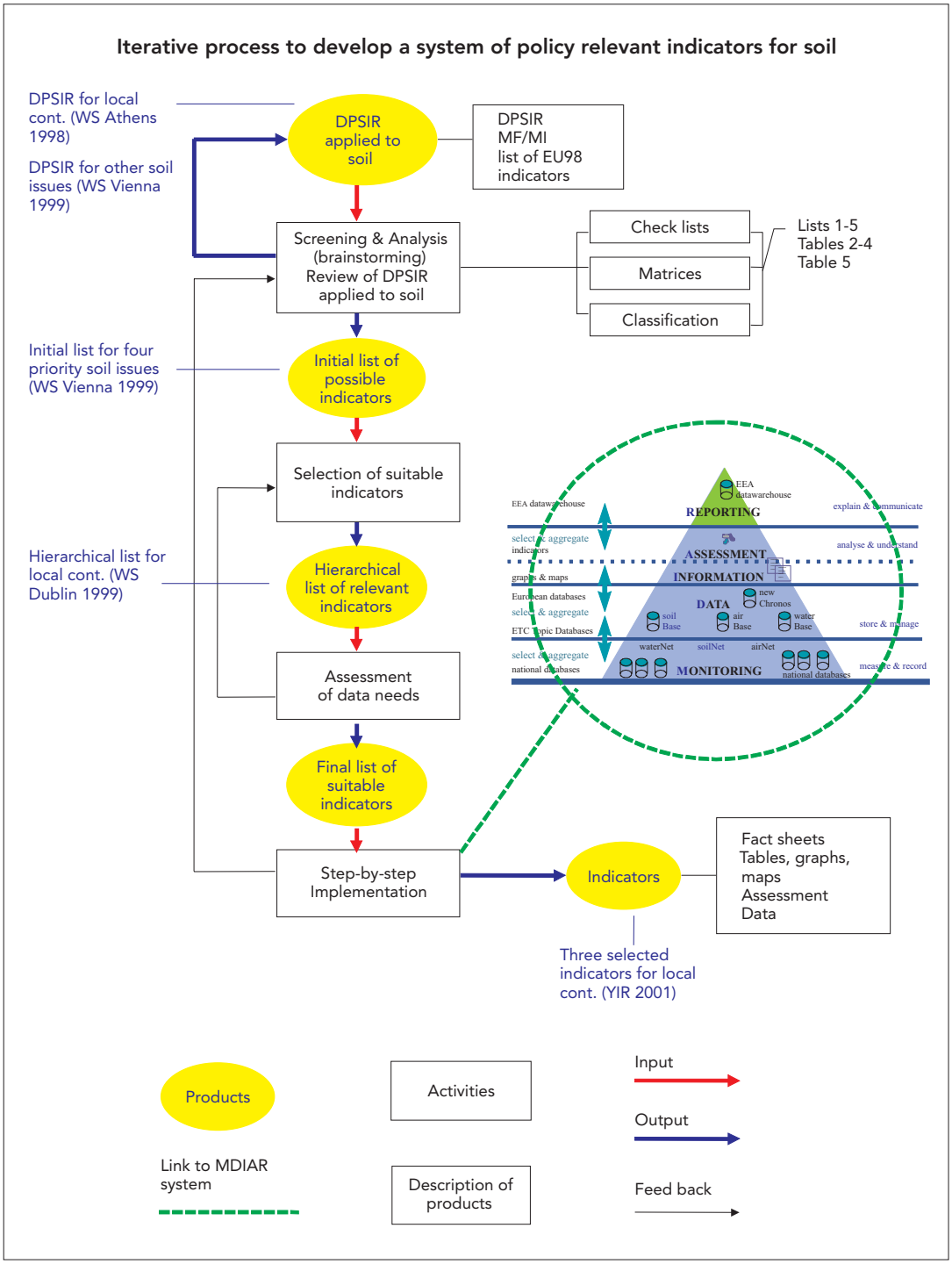
The EEA work on soil indicators and the development of the framework started in 1996 with work on indicators on contaminated sites and continued with the preparation of a tentative list of policy-relevant indicators, the assessment of data needs and data gaps and the development of a restrict number of indicators on local contamination, soil erosion and soil sealing.

Results of this work have been published in EEA reports (EEA, 1999; EEA, 2000; EEA, 2001c).

The EEA, with the support of the ETC on Soil, organised a workshop in Vienna from 12–14 October 1999, where a proposal for a common framework for the assessment and monitoring of soil in Europe was presented. The scope of the workshop was to get to a common understanding and to agree on the way to proceed towards the implementation of the framework.

The proposal contained an initial list of policy-relevant indicators on soil to be used in EEA reporting and to support the development of soil protection policies. Furthermore, it identified a basic set of soil data that are needed to feed these indicators and that should be considered for soil monitoring at the European level. The initial list of indicators was further developed for local contamination. At the EEA technical workshop on contaminated sites, held in Dublin in November 1999, a draft hierarchical list for local contamination was presented and discussed. Three indicators of the list were selected and included in the 2001 issue of the regular indicator-based report, Environmental signals 2001 (EEA, 2001c) Figure 2 shows the process devised for the development of soil indicators.

Figure 2 **Iterative process to develop a system of policy relevant indicators for soil**



2. Workshop minutes

The workshop was organised in three main sessions: an introductory session where the concepts and the approach of the work were discussed, and two technical sessions focusing on the EEA proposal for indicators on local and diffuse contamination.

It is worth mentioning here that diffuse contamination and local contamination are often treated as distinct soil problems. Diffuse contamination is generally caused by contaminants transported over wide areas, often far from the source. Local contamination (contaminated sites) is a problem in restricted areas (or sites) around the source, where there is a direct link to the source of contamination. This distinction has an historical origin and it is mainly made in relation to the different management, legal and liability aspects involved. Both types of degradation may be present within the same problem area or 'hot-spot', such as in highly-contaminated areas around cities where soil pollution is caused by localised sources (e.g. landfills) as well as road transport (EEA, 2000).

The need to go beyond this distinction and develop a more integrated approach to soil contamination was recognised during the workshop.

2.1. EEA indicator-based reporting

The workshop started with the EEA introducing the workshop objectives, the progress achieved in the EEA soil work since the last Eionet soil workshop in 1999 and the plans for the future. The presentation focused in particular on the relevance of indicator development for EEA reporting. Several issues on how Eionet could contribute to the work in terms of helping define client needs, providing data and expertise were also discussed.

The work plan and the continuation of the work within the new European Topic Centre on Terrestrial Environment were also discussed.

In particular, the priorities of EEA work on soil in 2001 were to:

— continue work on soil contamination (indicators + Eionet workshop);
— review work on soil erosion and soil sealing (2 expert workshops);
— review work on hot spots (Eionet consultation);
— fill the gap between ETC on Soil (ETC/S) and ETC/TE; and
— provide input to the work of the new ETC/TE.

A more detailed account of the EEA presentation is included in Annex I.

The Austrian Federal Environment Agency (UBA Vienna) provided a detailed account on the progress achieved by the EEA in the development of policy-relevant indicators with the support of the European Topic Centre on Soil (ETC/S). Substantial work was carried out in particular in the field of soil contamination from local sources. A summary of UBA presentations is included in Annex I.

The main points discussed in the introductory session are summarised below.

- A major fact that should be considered when analysing the role of soil indicators as a tool for the definition and implementation of European soil protection policies is that so far there is no direct soil protection legislation in Europe. However, some EU directives and policy instruments are closely related to soil protection. To help rise the profile of soil protection in the political agenda, direct contacts with the clients, that is European and national policy-makers, should be improved.

- The EEA should continue its work on soil indicators. High priority to soil work and in particular to the work on soil contamination should be given in the definition of the terms of reference and work programme for the new ETC on Terrestrial Environment (ETC/TE). This would ensure continuity of the work developed so far and contribute to fill the policy gap.

- Nevertheless, the development of soil work should reflect the changed context and the broader approach chosen by the EEA in developing the work programme on soil and land-related issues, to be integrated in the wider issue of terrestrial environment.

- In relation to the work on local contamination, Eionet partners expressed concerns on the choice of impact levels for the classification of contaminated sites. In fact, there are no standard definitions of impact levels across Europe and a common list of contaminants does not exist. It was agreed that the definition of impact levels should initially focus on human health, taking into account the actual and future/potential land uses.

- Due to problems with data comparability, caused by the different legal instruments in force even within a single country, the quantification of the extent of contaminated land as well as the assessment of its impact levels will be done at the national level. In this way, countries will not be required to adopt the proposed impact level definitions as long as there is no Europe-wide legislation in force.

- The establishment of a European monitoring and assessment framework is an EEA long-term objective which will require a lot of work in the coming years. A good start was to focus on the collection of existing data instead of on new monitoring. The information derived from existing data provides the basis for developing relevant indicators and also helps identify which additional data would be needed. Further activities may be necessary in the countries in the future to fill existing data gaps. These might include the establishment of a European soil monitoring network, which could help to improve comparability by harmonisation of methods.

The workshop proceeded with the two technical sessions on indicators for local and diffuse soil contamination. Country representatives had the opportunity to provide their feedback to the EEA proposal for soil contamination indicators. In particular they expressed their opinion on the relevance of the proposed indicators and provided information on the availability of national data. The results of the discussions are summarised in the following sections. A more detailed account of experts and countries presentations is included in Annex I.

2.2. Indicators for soil contamination from localised sources

Countries follow different approaches for data collection. All countries have set up some sort of data collection and monitoring system, but in very different ways, based on each country's own capacity. However, it seems that two sets of data are available:

— core set (e.g. number of sites);
— a variety of data from various sources, not always available as national aggregations.

In 1996, the EEA started collecting data on local contamination, focusing on those data that were easily available at the country level. Important improvements have been achieved so far in the development of indicators, but further work has to be carried out. Focus should shift from the collection of best available data to the collection of best needed data. This means that data should be gathered because they are useful and not simply because they are easily available. In this way more resources can be devoted to new monitoring activities aimed to fill data gaps.

One of the major reasons that the basis of existing problems with data collection on local soil contamination is the lack of reporting obligations for the countries, such as those established in the water framework directive and related to national water data. A further complication is that data is mainly gathered by regional and local authorities. The existence of an obligation for the countries to provide data would also help the NRCs to obtain data from the local levels. In order to streamline data flows it was suggested to define common parameters for reporting to the EEA and to make an official request. Countries are focusing on national rather than European data flows as so far there are no strong pressures to provide data at the international level.

One important step for the future could be to better identify the links and show the importance of soil protection to achieve objectives and targets established in existing legislation (e.g. the water framework and the landfill directives). Making these connections more evident would provide a stronger justification and pressure on the countries

for establishing European soil data flows and improving national monitoring systems.

Moreover, the assessment of impacts of soil contamination should show the effects of contaminated soil on human health.

It was recommended to focus on a stronger consideration of 'client needs', such as to support the general integration process and to identify integration needs, in order to provide more policy-relevant information. A stronger link to EU reporting obligations and regulations should be considered. Integration of the IPPC directive and eco–management audit could be taken into account.

Priorities for further development of indicators

The participants were asked to assess each proposed indicator against its importance and availability of data. Details on the evaluation procedures and results are provided in Annex IV.

On the basis of the evaluation, it was possible to identify the five indicators considered to have both a high degree of environmental and policy relevance and are feasible in terms of data availability:

— soil polluting activities;
— number of contaminated sites;
— progress in contaminated sites management;
— expenditures on remediation activities;
— groundwater incidents.

The indicated data availability corresponds quite well with the importance of the indicators. The lowest ranking both for importance and data availability was given to the indicator on the amount of hazardous substances in soil.

Nevertheless, there seems to be a high correlation between the ranking of the importance of each indicator and the availability of data. For example, although the importance of collecting data on brownfield issues was considered high during the discussion, the relevance of the related indicator on brownfields, for which availability of data is low in most of the countries, was considered low in the evaluation.

The recommendations of the countries on the importance of indicators and data availability are an important input to the further development of indicators. In a long-term perspective, however, the policy relevance of additional indicators for which data is now scarce should also be taken into account.

2.3. Indicators for soil contamination from diffuse sources

An overview of the work done for developing indicators for diffuse soil contamination was given, showing the state of work and introducing the proposed priority indicators.

The main objective of the work was to identify and to select the most relevant indicators.

Following the feedback on the proposed indicators by the representatives of Germany, Denmark, the Netherlands and Italy, the other country representatives made short statements, reflecting the national position on the proposed indicators.

Some of the proposed indicators were considered significant, but most of them should be better specified and combined in an appropriate way in order to answer the relevant policy questions. Additional indicators were also proposed for the assessment of diffuse soil contamination. These are listed below:

— aquifer salinisation, pressure indicator;
— heavy metal balances on test sites, state indicator;
— relation of heavy metal content from topsoils to subsoils, state indicator;
— content of aromatic hydrocarbons, state indicator;
— eutrophication of surface water, state indicator;
— crop quality, impact indicator.

During the discussion, it was often recommended to work together with other ETCs and to use existing data from already established soil monitoring networks, such as the UN-ECE ICP forest programme or databases such as Corine Land Cover and the JRC European Soil Information System. However, access to existing data may be a problem due to existing restrictions in data distribution policies.

The Foregs database could also be used. It contains soil data from 25 countries, including data on the content of heavy

metals in topsoil and subsoil. Since the content of heavy metals depends on geology and land use, the newly proposed state indicator on the ratio of heavy metals in topsoils to subsoils was regarded as a good alternative to the proposed indicator on the exceedances of critical loads of heavy metals in soils, especially for the Scandinavian countries.

It was also mentioned that the mobile fractions of heavy metals were important to indicate contamination from diffuse sources, when harmonisation methods for data can be established or comparable data can be provided.

The heavy metal balance was often regarded as a very important indicator, as soils definitely act as a sink for heavy metals. Although the knowledge about this issue is still very vague, especially on the outputs from soils, first steps should be undertaken on some test sites to reach a better understanding on this important soil issue.

Another point stressed during the discussion was to pay more attention to impact indicators, since they are often directly linked to policy issues (such as food quality, human health, forest health, eutrophication of surface waters).

Other remarks were made on a variety of issues. These are summarised below:

— consideration of the scale factor is important;
— transboundary pollution is focusing on critical load and critical levels;
— clear distinction of land use types is necessary;
— persistant organic pollutants and hydrocarbons should be considered;
— soil problems should be solved, not only monitored.

During the discussion some requests were forwarded to the EEA, including:

— NRCs would like to review the data from European databases (e.g. Eurostat) before they are used by EEA;
— the EEA should support the NRCs to get regional data to produce aggregations at national level;
— there is a need for more transparency concerning 'who gets the national data' and more transparency on information sources to ensure better quality checks to be provided by the NRCs;
— it would be important to establish links to soil sealing and soil erosion indicators.

Priorities for further development of indicators

In order to get a clearer picture on priorities (mainly driven by political relevance) and feasibility (mainly depending on data availability) of the indicators the country representatives were asked to evaluate the proposed indicators for their priority and for their feasibility. Details on the evaluation are presented in Annex V.

The indicators considered of high importance are listed below:

— average pesticide consumption per unit area of agricultural land;
— sewage sludge application per unit area of agricultural land;
— exceedance of critical loads of heavy metal contents in soils related to different land uses;
— heavy metal balance for agricultural land;
— organic carbon or humus content in top soils related to different land uses;
— occurrence of key species in soils.

However, national data was easily available only for one of the indicators proposed, the pressure indicator 'Sewage sludge application per unit area of agricultural land'.

In relation to this indicator, it was often emphasised that its relevance was directly linked to the quality of the sewage sludge used. Depending on the quality of sewage sludge, which primarily refers to the average heavy metal content, the applied amount of heavy metals can vary widely. Therefore the proposed indicator would become more precise, if data on the amount of different types of sewage sludge used in agriculture are available. As a further step it would also be important to consider the content of organic pollutants in sewage sludge as a possible indicator.

The new indicators suggested by participants at the workshop were of course disadvantaged in the evaluation, since the time was too short to consider them in detail. But nevertheless they are good inputs and have to be considered further.

3. Workshop conclusions and follow-up

3.1. Conclusions

In general it can be recognised that the workshop was an important step in the development of indicators for soil contamination. It offered an open dialogue — the first time together with representatives of some new EEA member countries — in order to avoid misunderstandings and put all relevant issues 'on the table'. The points raised during the discussion provided insights on the way Eionet can contribute to the work on soil contamination and what are the needs of the clients.

The overarching objective of indicator development is to help show the impacts of economic sectors on the environment, in particular on the soil environment. For example, the use of indicators can help identify any relationship between the economic progress in the agricultural sector and its impacts on the state of the environment, for example by use of fertilisers, pesticides and sewage sludge. Once the impacts are known, it would be possible to devise policy measures for their reduction.

The major points raised or agreed at the workshop can be summarised as follows.

- There is a general agreement on the list of proposed indicators but the work should focus on a smaller number of indicators.
- For some indicators most of the countries declared to be able to deliver data directly on request or in 1–2 years time at the latest.
- Indicators on impacts of soil contamination and type 'B' (performance) indicators are considered the most important (relevant impacts include effects on food quality and production; ground and surface water, biodiversity, forest health).
- Policy relevance is not given by a single indicator but by a 'combination' of indicators. That is, in order to make a policy-relevant assessment, two or more indicators should be analysed (e.g. trends in driving forces and changes in state and impacts; changes in state and related impacts; responses and state etc.). In EEA terms, this means that it is important not only to provide information on the single elements of the DPSIR but also to analyse the interconnections between them.
- Links to the work of other ETCs are important for more comprehensive assessments. Collaboration with the European Topic Centre on Water on effects of local contamination on groundwater quality and availability was suggested.
- There is a need to go beyond the definition of local and diffuse contamination, adopt a more integrated approach to soil contamination and show the connections between soil contamination, soil sealing and soil erosion.

Countries also expressed further requirements to the EEA which include the clear indication of data sources to help country reviews, a better clarification of EEA needs, the support from the EEA to get data from regional authorities and the addition of soil sealing and soil erosion indicators. The off-site effects caused by these patterns of soil degradation have to be considered in the future.

Furthermore, the countries recognised very important improvements in indicator work done so far, although further work has still to be carried out. It was generally stated that it was useful to make data and reports available through the EEA web site. However, difficulties in retrieving information from the EEA web site were pointed out ('getting to the right place is not very easy'). Moreover, the countries should be reporting to the European level only once in order to avoid duplication of work. The inclusion of soil contamination issues within the new European Topic Centre on Terrestrial Environment was endorsed.

3.2. Follow-up of the workshop

As agreed at the workshop the member countries were asked to fill in a questionnaire, summarising the country position on the proposed indicators for diffuse soil contamination. Only 'new' indicators scored as 'important' and at least

'partly feasible' during the evaluation at the workshop were included in the questionnaire. Other indicators for which data that can be derived from international data sources (e.g. Eurostat, OECD) were not included. An analysis of the results of this consultation and the results of a data update request on local soil contamination which was sent out before the workshop, together with recommendations for further work were compiled in a report on data needs and data availability for the development of indicators on soil contamination. The report is foreseen by mid-2002.

The results achieved by the working group on soil contamination is an important input to the work of the new ETC/TE, which started operations in July 2001. It ensured continuity to EEA work on soil contamination and support to further EEA activities on soil.

The work on soil indicators is now integrated within the broader activity of development of indicators for terrestrial environment carried out with the support of the ETC/TE. Major progress so far has been the establishment of pilot priority data flows on soil contamination in 2001 and some steps towards the integration of the new EEA countries in the indicator work. A technical workshop on contaminated sites for Phare countries helped the process.

Priority data flows
The priority data flows on soil contamination from localised sources are partly an answer to the requests for a more systematic data collection made by the Eionet partners at this workshop. Regular annual deliveries are requested on a limited set of national data at this early stage of development and in particular on:

— percent contribution of localised sources to soil contamination;
— annual expenditure on remediation of contaminated sites;
— progress in the management of contaminated sites.

The results were encouraging: 14 countries provided data during the pilot by 31 January 2002 while four countries did not reply. The new EEA member countries were not included in the first stage of the pilot. A separate data collection for new EEA member countries was launched in February 2002 and is still ongoing. The results will be available by mid-2002.

Workshops
A technical workshop on indicators on soil contamination from local sources was organised by the ETC/TE and held in Vienna in December 2001. The workshop had the objective to integrate the new member countries into the development process of indicators on contaminated sites.

A workshop on indicators for terrestrial environment was organised by the ETC/TE and held in Barcelona in March 2002, with the objective to agree on a list of core indicators for terrestrial environment. Further work will be needed to consolidate the EEA proposal.

A technical workshop on indicators for soil contamination, building on the result of this workshop, is foreseen in May 2002 in Seville.

3.3. Policy developments

Important progress took place at the policy level. In fact, the sixth environmental action programme (6EAP) introduced a new strategy on soil protection for the European Union. The programme, proposed by the European Commission in 2001, lays down the Community action programme for the period 2001–10 in the field of the environment.

The 6EAP recognises that '..Little attention has so far been given to soils in terms of data collection and research. Yet, the growing concerns on soil erosion and loss to development as well as soil pollution illustrate the need for a systematic approach to soil protection ...'.

Moreover, '..Given the complex nature of the pressures weighing on soils and the need to build a soil policy on a sound basis of data and assessment, a thematic strategy for soil protection is proposed ...'. (European Commission, 2001)

In April 2002, the Commission published a communication on soil protection which is expected to be endorsed by the European Council and the Parliament by June 2002. (European Commission, 2002)

In a long-term perspective, the implementation of the work on indicators discussed in this report, would certainly contribute to improve the information basis needed to prepare, implement and monitor a sound European strategy on soil, in line with the priorities set down in the 6EAP.

References

EEA, 1999. *Environment in the European Union at the turn of the century*, Environmental assessment report No 2, European Environment Agency.

EEA, 2000. *Down to earth: Soil degradation and sustainable development in Europe.* Environmental issue series No 16, European Environment Agency.

EEA, 2001a. *Proposal for a European soil monitoring and assessment framework*, Technical report No 61/2000, prepared for the Eionet soil workshop in Vienna 12–14 October 1999, Vienna. European Environment Agency

EEA, 2001b. *European soil monitoring and assessment framework. Eionet workshop proceedings*, Technical report No 67/2001 European Environment Agency.

EEA, 2001c. *Environmental signals 2001,* Environmental assessment report No 8, European Environment Agency.

European Commission, 2001, 'The sixth environmental action programme', COM(2001) 31 final. 2001/0029 (COD)

European Commission, 2002, 'Towards a strategy for soil protection', COM(2002) 179 final.
Internet: http://europa.eu.int/comm/environment/agriculture/soil_protection.htm

Gentile, A. R., 1999, 'Towards the development of a system of policy-relevant indicators on soil', paper presented at the first meeting of the European Soil Forum, 24–26 November 1999, Berlin.

Annex I: Summary of workshop presentations

1. EEA indicator-based reporting

1.1. State of development of the EEA work programme on soil. Relevance of indicator development within the EEA reporting system.

Anna Rita Gentile
Project Manager for soil and contaminated sites, European Environmental Agency

Workshop objectives
During the Eionet workshop in Vienna (1999) basic aspects for the implementation of a European soil monitoring and assessment framework, the development of indicators and the establishment of a reporting mechanism for soil were discussed.

Based on the results of the Eionet workshop the main objectives of this more technical workshop are to:

— present result of current work;
— discuss the development of a selection of (priority) indicators on soil contamination;
— get information on availability of national data needed to develop the selected indicators.

Objective of EEA work on soil
The main objective is to contribute to EEA reporting through the provision of policy-relevant information on soil-related issues by analysing not only state and trends in the soil environment but also assessing:

— the causes of changes in state and related pressures acting upon the soil;
— the impacts on soil functions and other environmental media;
— the effectiveness of society's responses (policy measures).

This assessment is made through the development of policy-relevant indicators and the work is organised using a conceptual and operational framework for the assessment and the monitoring of soil in Europe based on the general EEA 'monitoring to reporting framework'.

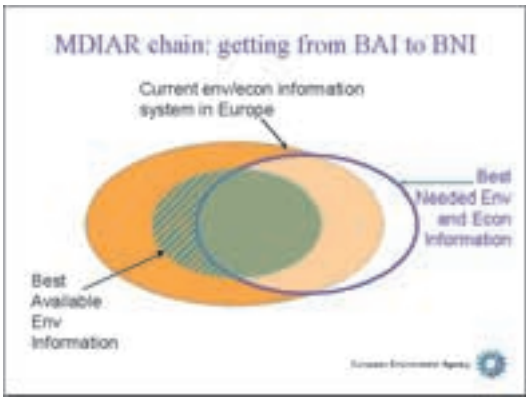
The European framework for the assessment and the monitoring of soil is based on:

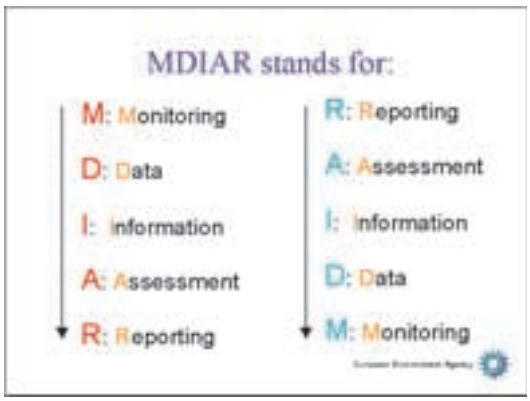
— political framework (priority issues); and the
— identification of relevant indicators (DPSIR, MF/MI).

and comprises the following activities:

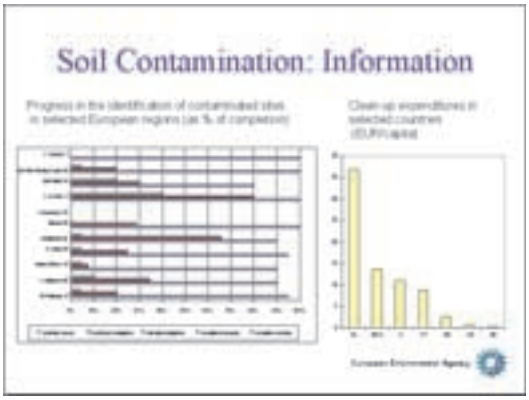
— definition of priority indicators;
— assessment of data availability and identification of data gaps;
— organisation of data flows (from national to European level);
— additional data collection (if necessary);
— assessment/analysis of data, aggregation to indicators;
— reporting.

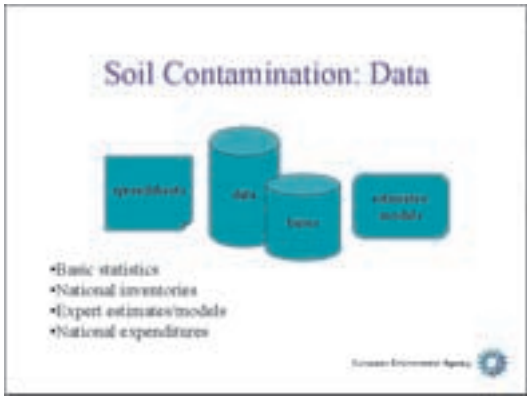
These activities have to be streamlined to get from best available information to best needed information.



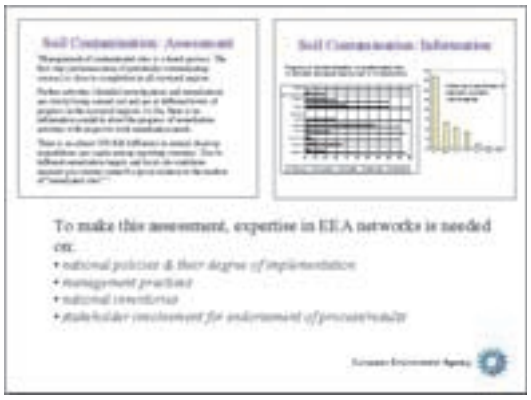


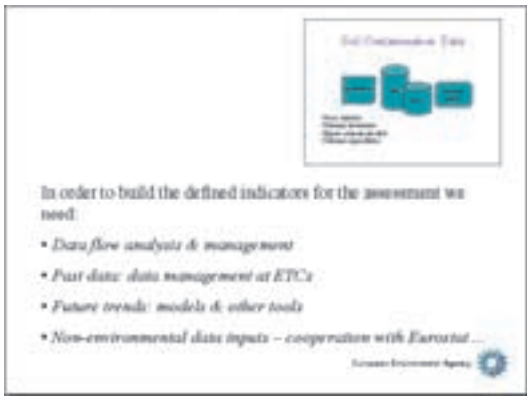
MDIAR applied to soil contamination (an example):

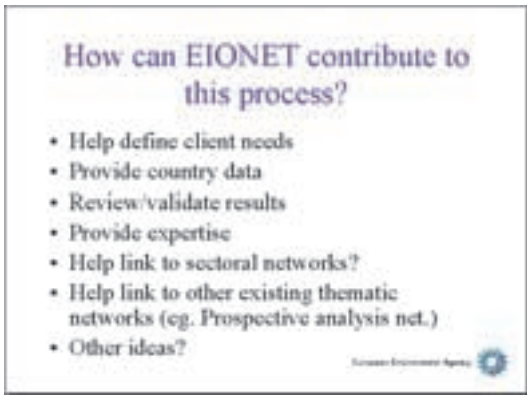




Expectations on the EEA and Eionet concerning required expertise, networks and processes







Current and future work

Currently the following working groups are carrying out work on soil aspects:

— working group on indicators for soil contamination;
— working group on indicators for soil erosion;
— working group on indicators for soil sealing.

Objectives of current work:

— fill the gap between the ETC/S and the ETC/TE;
— proceed on the work on soil contamination (indicators + Eionet workshop);
— review the work on soil erosion and soil sealing (2 expert workshops);
— review the work on hot spots (Eionet consultation);
— provide input to the work of the new ETC/TE.

The new ETC/TE timetable:

- deadline for proposals (9 February)
- evaluation of proposals (21 February)
- EEA recommendation to board (1 March)
- board meeting (20 March)
- preparation of technical annex (March–April)
- start (1 May).

Next EEA 'big' reports:

- **May 2001:** for the EU reporting cycle on integration for Gothenburg meeting (June 2001) → Environmental Signals 2001 with extended version on sectors
- **April 2002:** for UNCED (Rio+10, Autumn 2002) → Updates of the 2001 indicator fact sheets, plus essays on specific issues
- **September 2002:** Kiev Meeting (Winter 2003) → Environmental Signals 2002 for the UNECE/EPE with extended geographical coverage (pan-Europe)
- **2004:** for 6th EAP review → the 5-year State and Outlook report

Further work (ETC/TE)

- Further development of indicators on soil
- Extend the work to new EEA countries (enlargement — central and eastern Europe)
- Main outputs:
  —contribution to EEA 'big' reports
  —assessment of soil degradation in Europe (update of current assessment/soil message).

The objective of the soil message was to show priority areas and to identify and visualise data gaps in the fields of soil sealing, soil erosion, diffuse and local soil contamination and acidification. The provided maps can be regarded as 'spatial' indicators used for hot-spot identification. An update of the given results is envisaged.

1.2. Development of soil indicators as part of a European soil monitoring and assessment framework

Sigbert Huber
Austrian Federal Environment Agency, Vienna, Austria

Review of the proposal for a european soil monitoring and assessment framework (ESMAF)

The development of the framework started in 1996 with work on indicators on contaminated sites and continued in 1999 with the preparation of a tentative list of policy relevant indicators, the assessment of data needs and data gaps and the development of a restrict number of indicators on local contamination, soil erosion and soil sealing.

A proposal for a framework for the assessment and the monitoring of soils in Europe was presented at the Eionet workshop in Vienna 1999 with the aim to get a common understanding and to agree on the way to proceed towards the development of a European framework for soil, similar to those in place for air and water.

The proposed **European soil monitoring and assessment framework** will:

- identify priorities of soil problems;
- identify data availability and data gaps;
- provide for integration of relevant information from other environmental compartments;
- provide benefits for more comparable measurement of changes;
- produce information by development of indicators;
- enable a more comprehensive reporting on the state of soils in Europe.

The main parts of the **assessment of soil degradation** are:

- identification of relevant indicators and priorities;
- calculation of the indicators;
- validation of the achieved results;
- comparison with target values, threshold values and background values.

Since no European-wide framework for soil has been implemented so far, the most **serious data needs and data gaps** can be indicated in the fields of:

- adequate assessment of the current state or potential risk of soil degradation;
- comparable data on the loss of soil resources;
- large diversity in the design of soil monitoring schemes;
- full integration of the spatial dimension;
- use of remote sensing data needs to be explored;
- more analyses of measurements.

However, a European soil monitoring and assessment framework should be based as far as possible on existing activities in EEA member countries. Soil data feeds in many areas and is often required at different aggregation levels, depending on the needs of the users. The following points describe these levels and give some examples for the need of each aggregation level:

- local: useful to feed into local Agenda 21;
- regional: assessment of soils environment, effectiveness of regional policies;
- national: inter-regional comparison, effectiveness of national policies;
- European: inter-country comparison, effectiveness of European policies.

The expected **outputs** of the framework are as follows:

- agreed list of policy-relevant indicators on soil;
- suitable assessment procedures;
- improved data flow;
- more comparable data and information;
- European Soil Monitoring Network (SoilNet);
- standard set of measured parameters;
- creation of a European soil database (SoilBase);
- agreed reporting mechanism.

Finally the **benefits for the countries** turn out to be:

- enhanced data comparisons between countries (transboundary soil issues);
- improved data flow and data exchange;

— additional understanding of soil issues at different aggregation levels;
— extended communications on soil issues within countries;
— comparable format for reporting on soil to meet European requirements.

Conclusions of the Eionet workshop, 12–14 October 1999, Vienna
— recognition of the importance of the framework;
— detailed reporting mechanism is needed;
— comprehensive monitoring scheme has to be developed;
— problems of data comparability and harmonisation of methods are envisaged;
— integration of expertise of national experts is required;
— existing and analysed data should be used;
— selection of priorities in some areas is needed;
— countries without a soil monitoring network should be supported in developing it;
— state of soils and trends over time are of interest;
— information on driving forces and pressures should be gathered as well;
— short-term and long-term approach are needed.

Future work of the EEA concerning soil should focus on:

— local soil contamination
— diffuse soil contamination
— soil erosion
— soil sealing.

For all the issues the geographical distribution **across Europe** is an important factor.

Results of the questionnaires on ESMAF
At the Eionet workshop in Vienna 1999 the member countries agreed to respond to questions related to the presented framework and on the priorities for the development of policy-relevant indicators on soil (the long versions of the country responses can be assessed at the interest group (IG) 'Soil at the EEA' on the EEA Eionet homepage: http://eea.eionet.eu.int).

Referring to the priorities of policy-relevant indicators, soil contamination from local sources, 'soil sealing' and 'soil erosion' were considered as very significant soil issues for the short term. Soil contamination from diffuse sources and 'physical deterioration' were regarded as severe long-term problems, although 'soil sealing', 'local contamination' and 'salinisation' should also be considered important.

The availability of data is high in the field of contamination from local sources. This is due to the fact that hitherto soil activities were focused on that soil issue, which also explains that almost all countries consider local contamination an issue of short time priority. For the other priority issues data are available in nearly the half of the EEA member countries.

Next steps concerning soil indicators
Towards the development of indicators for soil contamination, in particular from diffuse sources, the further steps will be:

— analysis of needed information
— selection of priority indicators
— analysis of data needs
— investigation of available data sources
— identification of data gaps
— elaboration of an Eionet questionnaire
— development of a data flow.

1.3. Local soil contamination — past achievements and future goals

Martin Schamann
Austrian Federal Environment Agency, Vienna, Austria

The basis for dealing with local soil contamination was laid with the European Topic Centre on Soil (ETC/S), which started in 1996. Development of policy-relevant indicators has been major interest for the EEA within the Topic Centre. First steps were to provide a basis for future work, to review the management practises and the state-of-play in the various countries. The problems which have to be tackled are the following:

— different approaches for contaminated site management in EEA countries;
— different levels of progress in contaminated sites management;
— different definitions for 'contaminated site';
— different legal requirements.

Several basic reports have been published so far:

— *Topic report on contaminated sites: state-of-play: first common basis for further work* (published in 2000);

— *Management of contaminated sites and land in central and eastern Europe*, published by the Danish Ministry of Environment and Energy (as chair institution of the ad hoc group on contaminated sites), but with EEA ETC/S contribution;
— *Environment in the European Union at the turn of the century* (EU-98);
— *Dobris +3 report*;
— *Down to earth: soil degradation and sustainable development in Europe* (EEA 2000).

The first two reports form a comprehensive description of the state of art as regards local soil contamination in Europe.

From the **Topic report** the following aspects were concluded:

— data about local contamination are heterogeneous, not directly comparable;
— necessity to achieve agreements to make information EEA wide comparable;
— the term 'contaminated' is used differently;
— to avoid using 'contaminated' (sites) an agreement on using an 'impact level' model was reached in order to gain comparability of information based on environmental effects (see Table 1). As a consequence, the term 'contaminated site' as it is used in the countries can include different levels of environmental and human health impacts.

- Management of contaminated sites
  Management of local soil contamination is a tiered process, common elements are listed in Table 2.

Impact levels applied to contaminated sites and not contaminated sites Table 1

Level	Long definition	Brief definition
Level 0	Sites that do not pose any negative effects to human health or the environment → related environmental media can be used multi-functionally	No impacts; no use restrictions
Level 1	Sites where related environmental media have tolerable contamination levels and which do not pose a significant negative effects to human health or the environment → related environmental media can be used multi-functionally	Minor impacts (tolerable conta-mination); no use restrictions
Level 2	Sites that pose significant negative effects to human health or the environment if the use of the related environmental media changes to a more sensitive one → limited use of related environmental media	No significant im-pacts under cur-rent use of envir-onmental media, restricted use only
Level 3	Sites that pose significant negative effects to human health or the environment under current use of related environmental media → action is needed.	Significant impacts, action needed

The key steps of contaminated sites management Table 2

Preliminary survey	On the basis of available information the preliminary survey has the goal of assessing whether potentially polluting activities have taken place and whether contamination can be suspected. The results of the preliminary survey will in most cases classify a site as potentially (suspected) contaminated site.
Preliminary 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 contaminated. A variety of issues will influence the results of the preliminary investigation, the major issues being 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	The main site investigation is carried out to determine the need for remediation or other measures to eliminate or reduce the exposure to the contamination. Major goals are — to define the extent of the contaminated area and the degree of contamination — to assess the risks of the involved hazards.
Implementation of remediation activities	Suggested definition: Measures for reduction of environmental impacts have been started.
Remediation activities completed	Suggested definition: Monitoring of environmental media has proven that agreed remediation-targets have been met.

- Test areas
  Apart from answering questions focusing on data feasibility, availability and data quality at national level: development of indicators is done favourably at smaller geographical scale — regions providing high data quality and data availability:

- 1999: Selection of 11 areas (voluntarily) for testing of indicators. Results of data collection in these areas were presented in Dublin, November 1999.
  — Again main interest focused on available data. So far, no attempt laid on best-needed data!

- The main conclusions of the **Dublin workshop** are the following.

- **Expert estimates**
  Expert estimates were performed by all test regions and proved to be very useful to assess the level of progress related to the identification of potentially contaminated sites and contaminated sites, e.g. based on expert estimations the expected total number of sites per region could be calculated.

- **Data comparability**
  Results of the test data collection were related to a variety of comparable units on the one hand:
  — 1 inhabitant
  — 1 km² surface area
  — 1 km² artificial surface.
  and to comparable urbanisation parameters on the other hand, such as:
  — a standard population density of 100 cap/km², and
  — a standard density of artificial surface of 5 %.

Results showed clearly that data related to contaminated sites strongly depend on the different urbanisation levels. It proved to be most useful to relate the results to comparable units and to comparable urbanisation units.

- **Benchmarking**
  The definition of minimum and maximum values in relation to comparable units could be performed in the following cases:
  — the surface of contaminated sites (impact level 2 and 3) in relation to comparable units and comparable urbanisation parameters;
  — expenditures for main site investigations (characterisation of sites at impact level 2 or 3) per m² of investigated area.

Information can provide a basis for more complex views on local soil contamination.

- At the **Eionet workshop Vienna, 1999** a comprehensive view on 'Soil monitoring and assessment' was established.

- Three indicators (out of a hierarchical list) were selected and included in the **Yearly indicator report YIR (2001):**
  — soil polluting activities from localised sources;
  — expenditures for cleaning-up of contaminated sites; and
  — progress in the management of contaminated sites.

Based upon so far collected data and information, fact sheets (including tables, graphics, draft assessments and real data) have been elaborated. Due to already gained information, the availability of data dominated the selection of these three indicators. Therefore it is not necessary that these indicators have to be focused on with highest priority in the future (stepwise approach!).

Planned future development

- moving away from 'best available data' towards 'best needed data';
- broader view of soil contamination;
- stronger consideration of EU policy with regard to indicator development e.g. water framework directive; sustainable urban development;
- closer cooperation with other ETCs (Water!) — first steps for defining common interests already started;
- expand present focus (management of local soil contamination), e.g. progress in contaminated sites management, to problems due to environmental impacts caused by local soil contamination (e.g. quantity of hazardous substances in soil, impacts into groundwater, affects for drinking water supply);
- focus prior on hot-spot areas, rather than on a total EEA coverage;
- test areas: continuation of the testing of indicators in selected regions (high data quality).

2. Indicators for soil contamination from localised sources

2.1. Presentation of the proposal for the local soil contamination indicators

Martin Schamann
Austrian Federal Environment Agency,
Vienna, Austria

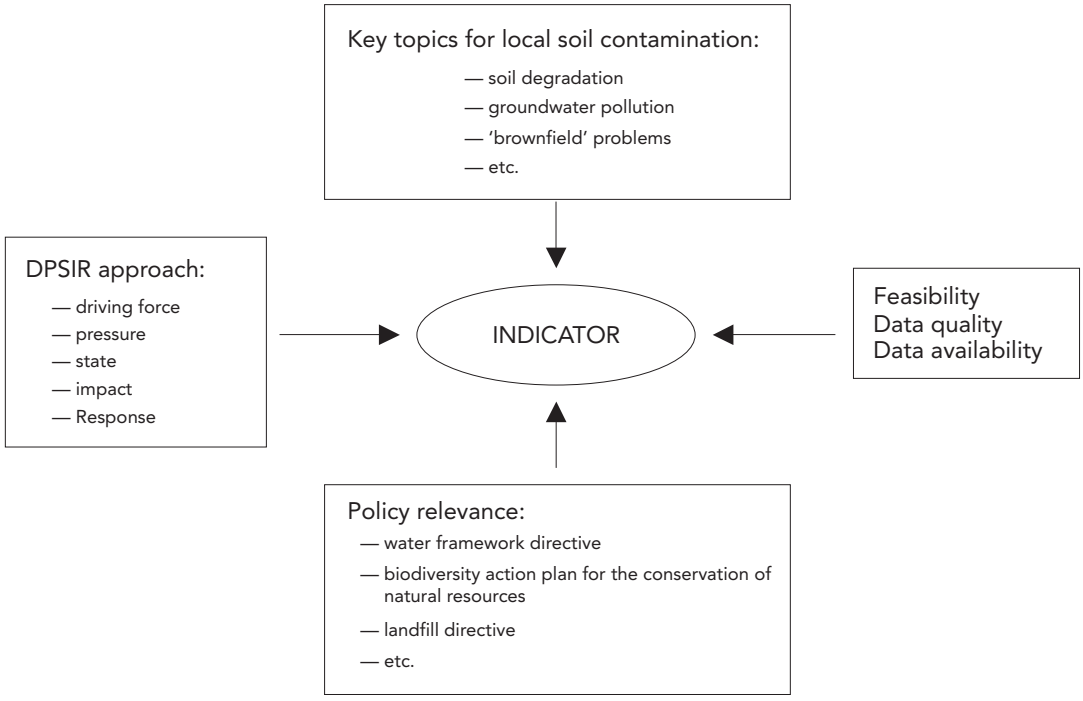
Short-term/long-term approach
Since EEA reporting obligations require information on the state of the environment on a short-term basis, the focus was put on best available data so far. This aspect led to the fact that prior information on management of contaminated sites has been collected (availability). However, the development of policy relevant indicators also requires a broader view of information/ data sets.

Due to the fact that contaminated site management is a long term approach and just first steps have been made, available information focus on basic steps of contaminated sites management (site identification, investigation), rather than on advanced steps in the managing process.

Requirements for the development of policy-relevant indicators
In the light of EEA further activities the basic approach so far is extended by moving to the best needed data. By doing so, the frame-conditions illustrated in Figure 3 are to be respected.

Respecting the above frame conditions a draft list on possible (long-term approach) indicators has been introduced at the second workshop on contaminated sites (Dublin 1999). Conclusions and further work on the development of indicators led to the reviewed list included in Table 3.

Frame conditions for the development of policy-relevant indicators Figure 3



Draft indicators Table 3

DPSIR element	Indicator description
Driving forces/pressure	Soil polluting activities
State	'Number of sites' corresponding to impact level Amount of hazardous substances in soil
Impact	Incidents of groundwater impairment deriving from local contamination Impairment of drinking water supply in river basin districts
Response	Expenditures on remediation activities Progress in contaminated sites management Reused (reclaimed) contaminated land in relation to consumed green land

These draft indicators were subject for discussion at the current workshop with the following inputs:

- agreement on suggested reviewed draft indicators for further development;
- data availability/data quality at national level;
- feasibility of development of policy relevant indicators;
- further requirements/data gaps;
- recommendations.

Proposed draft indicators for further development

Soil polluting activities from localised sources
Key information:
— Indication of the variety of soil polluting activities
— In addition to historic contamination, new contamination takes (can take) place.

Policy relevance:
(with respect to present pollution)
Several measures for prevention of new contamination have been initiated due to progress in the state of the art for industrial plants.
The more the input of hazardous substances into soil is controlled the more the environmental stress for soil and groundwater is reduced. This is achieved through the improvement of environmental standards for industrial sites referred to new contamination and related to, for example, the handling of hazardous substances (ippc directive, landfill directive, groundwater directive) and, additionally, through the clean-up of historical contamination.

To be clarified:
Should the aspect of prevention of new contamination be considered within the subject?

Number of sites
Any kind of 'number' or 'size'/'area of site' forms a key parameter for indicators.

Key information:
Basic key parameter for the estimation of the extent of contaminated sites problems.

Comment:
So far, various different fundamental data based on 'number' and 'size' of sites have been collected at national or regional level, providing the basis for further development of indicators, e.g.— number of sites per impact level
— surface of sites per impact level
— number of remediated sites

In most countries 'number' of sites at question are the easiest available data on that problem. Therefore collection and assessment of most relevant data should be continued.

Amount of hazardous substances in soil
Question:
What is the impact of hazardous substances into soil caused by local contamination?

Key information:
estimation on total amount of impacts into soil/potential of contamination in soil

Policy relevance:
exceeded legal requirements with respect to soil and groundwater quality due to augmentation of contaminants in soil

Comment:
broad spectrum and variety of contaminants;
high risk for human health;
impossible to deal with all substances at once;
→ focus on main contaminants, like CHC (chlorinated hydrocarbons) and mineral oil.

Presented example:

Total amount of CHC in soil (estimation/ Austria)
Basis: average site conditions (no site specific differentiation), average impacts

— 50 000 sites with considerable CHC contamination nationwide
— 90–95 % of all sites CHC impact approximately 1–5 kg per site
— < 1 % of all sites CHC impact > 1 t
This assumption leads to the long guess of 10 000 t of CHC impact nation-wide (caused by local sources).

Incidents of groundwater impairment — impairment of drinking water supply in river basin districts
Question:
How great is the effort due to local soil contamination for providing drinking water?

Key information:
Impact of hazardous substances into groundwater due to local soil contamination are a severe risk for the maintenance of drinking water supplies. Mostly river basins are affected.

Clean-up expenditures per capita Table 3

Clean-up expenditures per capita	Total Expenditures (million EUR)	Pop (million inhabitants)	EUR per capita
Spain	14	38.9	0.4
Germany	57	79.4	0.7
Sweden	23	8.8	2.6
Austria	67	7.7	8.7
Liechtenstein	0.33	0.03	11.0
Belgium	78.6	5.8	13.6
Netherlands	550	14.9	36.9

Source: EEA 2000.

Policy relevance:
— repair: in case of already affected drinking water supply systems measures to meet national and international water-quality criteria have to be induced.
— precaution: e.g. water framework directive: ensure progressive reduction of pollution of groundwater and prevent its further pollution.

Required basis-information for indicators (to be discussed):

- any kind of information on impairments due to local soil contamination such as:
  — number of public drinking-water supply facilities closed down;
  — number of private drinking-water supply facilities closed down;
  — number of drinking-water supply facilities where purification is essentially;
  — costs for drinking-water purification due to contamination deriving from local soil contamination;
- any kind of information on possible impacts on groundwater caused by localised sources with regard to sensitive groundwater bodies (in cooperation with ETC/Water), e.g. number of sites at different impact level per km^2 or per capita;
- density of potentially contaminated sites in sensitive areas;
- amount of hazardous substances in soil (e.g. CHC) in sensitive groundwater areas.

Expenditures on remediation activities
Question:
What amount of money has to be provided to fulfil legal environmental requirements?

Key information:
For remediation activities huge amounts of money (public, private) have to be provided (see Table 4).

Policy relevance:
A variety of countries attempted to estimate the total costs for remediation activities. Several countries provide considerable amounts of state money for remediation activities.

Comment:
- the amounts of money cannot be compared directly, but indicates public awareness of the problems
- so far, several countries already estimated the total amount, update is required in current questionnaire

Progress in the management of contaminated sites
Key information:
Management of contaminated sites is a long and stepwise process. In general, site identification and investigation are far advanced, whereas remediation activities are in the preliminary phase (see figure 4).

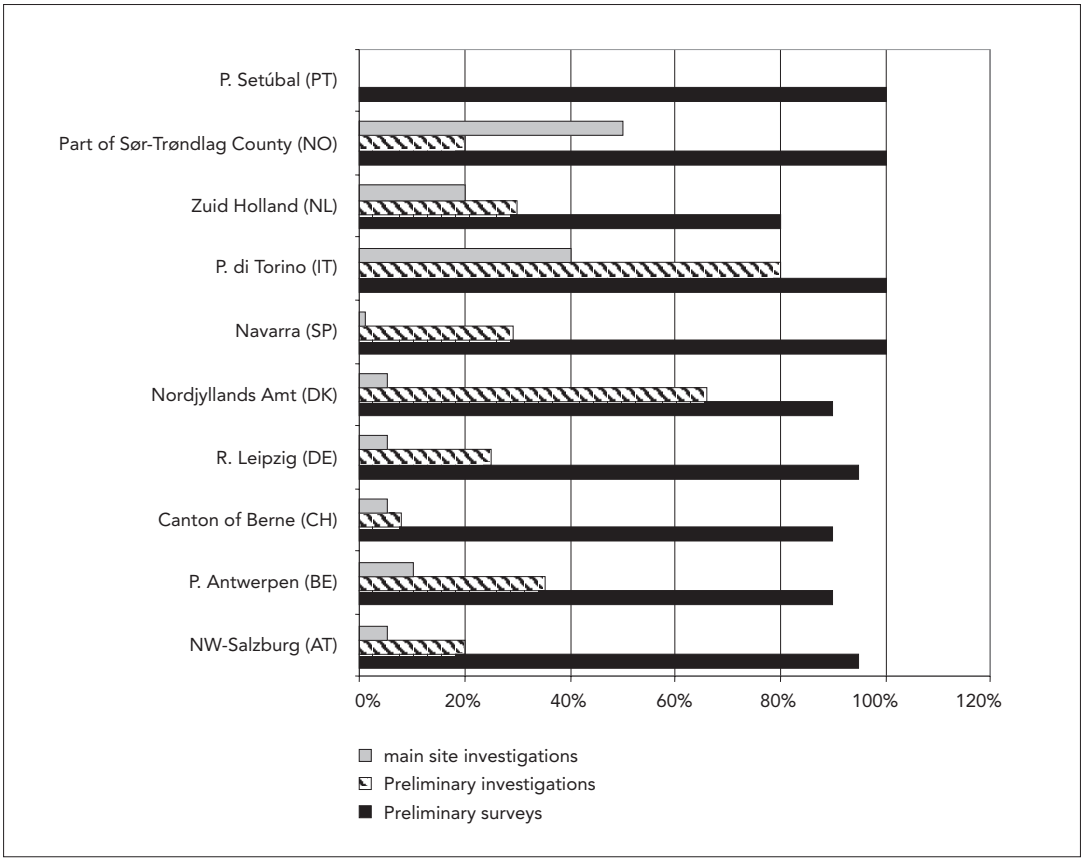
Policy relevance:
Sites assigned to a certain impact level exceed quality levels for soil or groundwater (due to emission from local contamination).

The interest is focused on resuming the prescribed quality criteria.

So far suitable information has been gathered for 10 test areas (see figure) — limited information on first steps of management process — site identification (Dublin, 1999).

Availability of data at national level is subject for further discussion.

Figure 4 **Progress in the management of contaminated sites in selected European regions**



Reused (reclaimed) contaminated land in relation to consumed green land

Question:
How big is the extent of brownfield sites and the potential of their re-use?

Key information:
The intention to locate industrial or commercial enterprises on 'green land' is more or less intensely counteracted through measures regarding the re-use of former industrial areas (brownfields).

Policy relevance:
With respect to a sustainable urban development, reuse of former industrial sites is to be supported related to further consumption of green land.

The biodiversity action plan for the conservation of natural resources foresees preservation and creation of green corridors in urban or suburban areas.

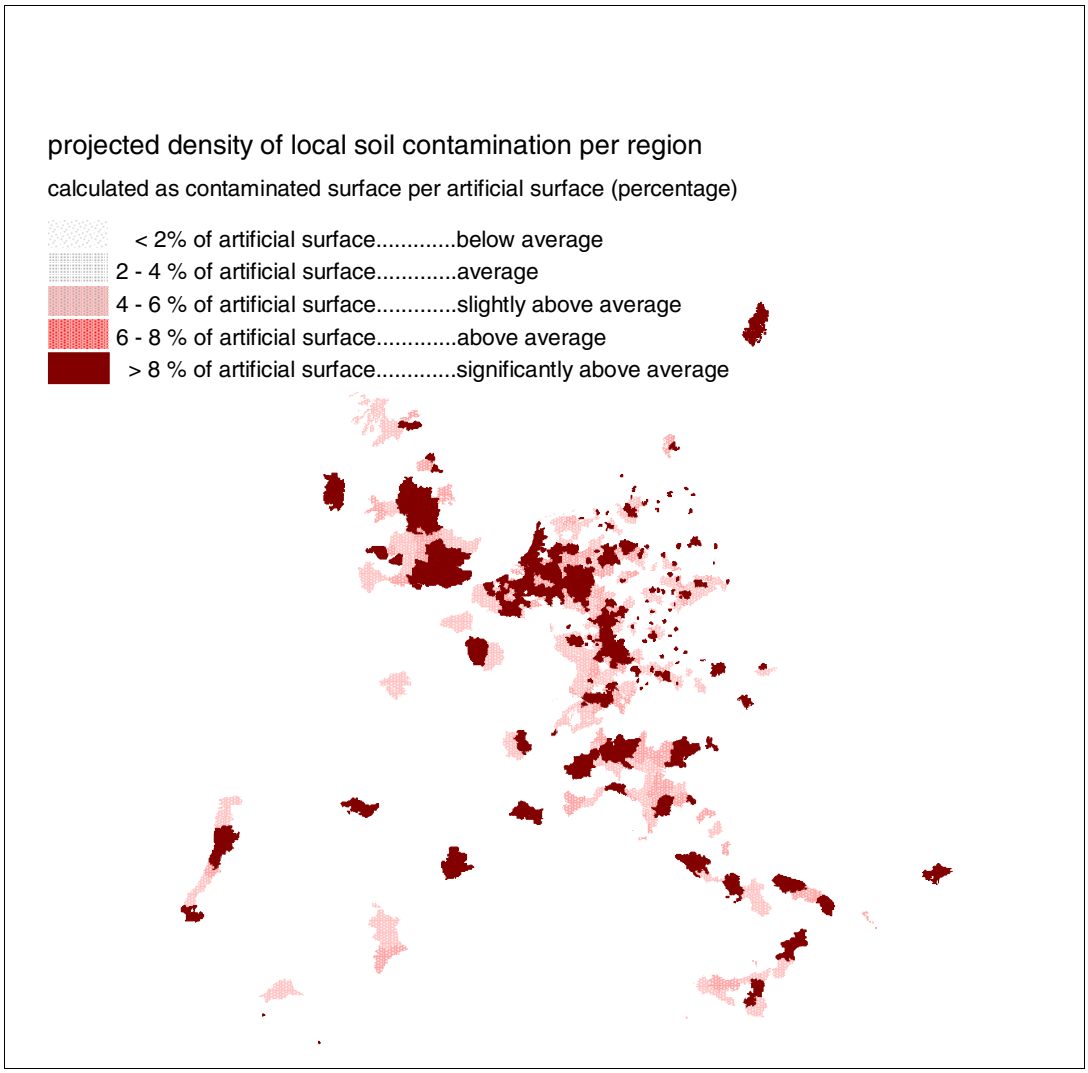
Requirements for indicators (to be discussed)
Any information on abandoned sites and consumption of green land, e.g.:

— total amount of abandoned sites in urban areas (per year);
— yearly amount of land consumption due to development of industrial / commercial enterprises;
— percentage of brownfields reused in relation to total need for industrial land;
— number of houses built on brownfields;
— distance to a policy target (if existing).

Questionnaire — Part-local soil contamination
As an additional support for decision making on the further development of indicators, a questionnaire has been sent out to Member States. In this questionnaire more detailed information on these indicators was asked. With regard to the development of sound policy relevant indicators for local soil contamination the main intention of the questionnaire is to provide information about data availability at national or regional level and data collection at national level. The following analysis of the questionnaire is essential for the process of a regular data collection and assessment.

In order to get from the 'best available' to the 'best needed' data the following aspects have to be taken into account:

Projected density of potentially soil contamination per region — Figure 5



— Stronger consideration of EU policy with respect to local soil contamination e.g. water framework directive;
— Focus on environmental impact assessment; soil, groundwater, brownfields (in addition to contaminated sites management);
— Focus in hot spot areas.

Priorities for further activities

- EEA is interested in getting information on total geographic coverage.
- Due to lack of information it is not possible to provide complete and exhaustive data at once.
- Any kind of local 'prioritisation' is suggested (hot-spot areas).

Two approaches are adopted:

1. 'Modelling' approach
   Population density creates basis for prediction of hot spot areas (see Dublin WS/11 test areas):
   —population density — 100 cap/km²
   —area of local soil contamination can be expected to be on average 2 % of artificial surface (see Figure 5)
   —sites correspond to impact level 2 or 3
   → for regions with higher population density, the expected affected total surface is higher.

2. 'Actual contamination' approach
   This approach for identifying 'hot spot areas' is used in the report 'Down to earth: soil degradation and sustainable management in Europe'. The reported contamination creates a basis for the prediction of hot spot areas.

   The more contamination are reported in a defined region, the higher is the probability of further contamination. The location of zones with high probability of soil contamination (through e.g. heavy industry) and zones where actual soil contamination has been

reported can be illustrated. Since there is no harmonised monitoring of local soil contamination in Europe and some countries do not yet have national inventories a proxy data has to be used for e.g. heavy industries.

2.2 Country sessions — feedback on the proposed indicators for local soil contamination

The representatives of the following countries were asked before the workshop to give a presentation as a feedback on the proposed indicators for local soil contamination. As these presentations contain also their country statement, these countries are not further listed in section 2.3 of this Annex.

Belgium
Eddy Van Dyck
Department: Soil — remediation
OVAM, Mechelen, Belgium

Wallonia and Brussels
No strict regulations to tackle the total soil contamination exist so far, but they are in preparation. Only partial regulations exist (for example for service stations).

Region of Flanders
Legal aspects: decree on soil remediation 22 February 1995
Responsible authority for soil remediation: OVAM (centralised structure)
Data management: register of contaminated sites — OVAM
Data collection: reports/audits — licensed site professionals
Database: alphanumeric database, geographic information system (in preparation, will be finished in 2001).

There is no tradition of using indicators in Flanders. The annual report gives information on the number of sites, the progress of remediation and the remediation expenditures.

- Soil polluting activities
  Past/actual situation:inventory of potential polluting sites — OVAM
  Soil investigation reports — OVAM
  Near future: inventory of soil threatening activities — cities (copy ? OVAM)

- Number of sites
  Data can be provided on soil polluting activities, potentially contaminated sites and proven contaminated sites.

- Groundwater impairment
  So far, no public water supply had to be closed down — data would be available but it does not seem to be of great importance.

- Expenditures
  Expenditures on remediation are well known — even the privately spent money (obligation to inform OVAM).

- Brownfields
  Data collection on brownfields is in operation. Subsequently information on area/size of brownfield can be provided.

Denmark
Irene Edelgaard
Department: Soil contamination
Danish Environmental Protection Agency, Copenhagen, Denmark

Soil polluting activities from localised sources
The indicators used till now: (industrial activities; Municipal waste disposal, Accidents, Others) reported as a percentage of the total. The Danish EPA cannot distinguish between historical waste disposal on municipal waste and industrial waste. The reporting will as before be total for the two groups. (In the EEA's reporting the Danish data has been reported as solely municipal waste disposal, which is not the case).

Summary:
— many landfills with mixture of municipal and industrial waste → no clear distinction possible
— connection to diffuse contamination given.

Number of sites
If it is the intention to measure each country towards its own goal, it is important to describe the goal of each country.

For example: in the questionnaire concerning local contamination, the 'Estimation of the number of sites where preliminary investigation has to be carried out?' is asked. If the goal is not described, the reporting will not give much information on the actual situation. In Denmark all petrol stations that have been closed down are investigated and remediated according to a special scheme. As a consequence all petrol stations mapped on a basis of the preliminary

survey will be subject to a preliminary investigation. All other sites only will be subject to a preliminary investigation if the site is a priority site (risk of contamination of groundwater that now or in the future will be used for drinking water, sites used for housing, childcare institutions or public playgrounds).

Summary:
— better comparison with the countries' specific goals (so far no EU-wide legislation)
— protection level needs to be defined
— number at different impact levels (estimates available now, precise data in two years).

Amount of hazardous substances in soil
It is a problem to ask for estimates on specific parameters. Estimates are most often done in connection with political awareness on a subject, e.g. in connection with new legislation should be presented for parliament or evaluation of existing legislation.

In Denmark estimations are available on the total number of contaminations at national scale. Denmark can also provide the number on how many sites contaminated with petrol/oil are mapped according to the act on soil contamination, (also at regional level), or how many that are mapped according to the act because there is suspicion of contamination (also at regional level).

The Danish EPA does not distinguish between CHC and mineral oil. The reporting is carried out as a total for petrol and oil products.

It is important to be aware of what the reporting should include. It is not clearly specified if:
— the focus is on only existing contamination or also on the cases where remediation already have taken place;
— are all types of CHC, mineral oil contamination included? e.g. also contamination deriving from oil tanks used for heating of family houses?

No estimates exist on CHC impact between 50 and 100 t of HCH (or other amounts).

Summary:
— estimates for specific parameters at national scale — seldom available
— maybe carried out in connection with political awareness on a certain substance
— total amount of CHC not available.

Incidence of groundwater impairment at drinking water resources deriving from local soil contamination
It is possible to provide information on number of water supply facilities that have been closed down or affected by local soil contamination on regional level if the water supply facility supplies more than 10 households. But it is not possible to distinguish between private and public facilities.

The question is not quite clear. Is it the wish to collect information of the cost of new installations because the water catchment must be moved?

The Danish EPA can give information on average cost of new installation.

Costs of purification of water are also available.

Recommendations/needs to be clarified:
— definition of size of supply facility/ compared to total number of supply facilities;
— why distinguish between private and public wells?
— cost of installation of treatment facilities — why not cost of moving the water supply facilities to another area?

Impairment of drinking water supply in river basin districts
Geographic-coordinates (UTM-system) are available for all mapped local contamination. When the river basins have been digitised (it is not clear when) it should be possible to give information on the number of sites per km² or per capita.

Data availability:
— number of sites per m² or per capita possible as soon as river basins have been stipulated and digitised

Expenditure on remediation activities
It is possible at a national level to give a total estimate of the private and public expenditures. Information on the public expenditures can also be given at a regional level.

Data availability:
— public activities: possible at both national and regional level
— private activities: estimates possible at national level.

Progress in contaminated sites management
Estimation of the number of sites where preliminary investigation has to be carried out?

It should be specified what is meant by 'has to'. Is it the number included in the public investigation programme? Or could it also include other types of sites? In Denmark all petrol stations that have been closed down are investigated and remediated according to a special scheme. As a consequence all petrol stations mapped on basis of the preliminary survey will be subject to a preliminary investigation. All other sites only will be subject to a preliminary investigation if the site is a priority site (risk of groundwater that now or in the future will be used for drinking water, sites used for housing, childcare institutions or public playgrounds).

Estimation of the total number of sites where main site investigation has to be performed? As above what is meant by 'has to'?

Estimation of total number of sites where remediation activities are necessary?

'Are necessary'? According to what? Necessary according to present use and e.g. securing future groundwater resources for drinking water purpose or according to a potential future use of the area?

Clarification needed:
— How to include private activities (only when it corresponds to public activity or also outside priority areas)?
— the term 'necessary activity' needs to be specified (what activities)
— What kind of sites to be included (petrol stations yes or no)?

Reused (reclaimed) contaminated land in relation to consumed green land
There are no data available on:
— total amount of newly abandoned sites in urban areas per year
— yearly amount of land consumption due to the development of industrial/ commercial enterprises
— percentage of brownfield land re-used compared to a base year.

It will be possible to give some general answers on question 2 and 3.

One of the questions in the questionnaire focuses on the number of houses built on brownfields. What is the intention with the question? Is the intention to find out how many brownfields are developed (brought into use)? Building of houses is not always an indicator. For example, a site in the centre of Copenhagen, a former gaswork, was 'developed' approximately 5 years ago. The upper soil layer was remediated, a membrane divides the contaminated soil in the depth from the now clean top soil. After the remediation the site has been used as a football stadium whereas the gaswork building itself now is used as a theatre. But there have not been any new houses built. Houses can vary in size dependent on the land use.

Are private houses built on e.g. an old landfill, before knowledge of the contamination problem, also included in the definition?

Summary:
— Very limited data available for the time being — not directly assigned to brownfield problems; information if site is 'under use' or 'not in use'

The Netherlands
Esther Soczo
National Institute of Public Health and Environment; Bilthoven, Netherlands

Introduction
The main targets of the Dutch environmental policy plan are to quantify the extent of contamination in the soil before 2005, to remediate all urgent seriously contaminated sites before 2022 and to instigate permanent (active) management of all non-urgent seriously contaminated sites.

According to the Dutch Government, the monitoring of the number and current state of contaminated sites is necessary to be able to evaluate these goals and to manage the soil clean-up operation.

A national monitoring system (included indicators, database and network) for local soil contamination has been developed in the last four years in a joint action initiative of national and local governments.

General statements monitoring local soil contamination

- Monitoring of contaminated sites over the year 2000, using the new system, started officially in January 2001. Results will be reported to the Dutch Parliament in May 2001.
- This monitoring report will include the progress made in contaminated site management and the expenditures on remediation activities in 2000. The indicator for 'amount of hazardous substances in soil' is not included.
- The total number of potentially contaminated sites was estimated at 175 000 in 1997. A better estimation can only be given around 2004, when the intended (new) national survey of contaminated sites is completed.
- Indicators referring to impact of soil contamination are not included in the national monitoring system at the moment. In principle, the Netherlands is interested in the development of impact-relating (and effect-relating) indicators.

Response to proposed policy-relevant indicators

Draft (current) indicators

Monitoring contaminated sites (with the new system) over 2000 was officially started in the Netherlands in January 2001. The main indicators (also proposed by the EEA) are:

— the total number of contaminated sites by preliminary survey
— progress in contaminated site management and
— expenditure on remediation activities.

Moreover, a last category of indicators is formed by the administrative instruments:

— the remediation goals used
— the destination of soil becoming available during remediation and
— the use of juridical and financial instruments involved and spending related to the use of these instruments.

Data on these and other indicators (see table below) have been collected by the parties responsible and will be collected and reported yearly by the RIVM in cooperation with the parties involved (see more details below). The total number of potentially contaminated sites could not be estimated at the moment. This is only possible after the national survey is completed, thus around 2004.

More details on monitoring contaminated sites in the Netherlands

The national official monitoring started in 2001 after reaching a consensus on the indicators with the Ministry of Housing, Spatial Planning and the Environment and the parties involved. The table below gives an overview of the range of the indicators. The indicators include the number of (historical) sites in various stages of soil remediation actions. In the Netherlands the soil remedial actions, surveying and investigation are implemented by the provinces and large cities. Each stage of the remediation action is characterised by the number of sites, the size of the related polluted surface, the volume of related polluted groundwater and the economic dynamics/potential of the site. The number of sites due to recent contamination (after 1 January 1987) is also monitored, though these new sites are not treated according to the same rules as historic sites.

Indicators also include expenditures in the three main financial frameworks (national budget, Community Renewal Fund or private funding).

Overview of national indicators for local soil contamination in the Netherlands — Table 4

Stages of investigation and realisation	Characterisation of each stage	Administrative instruments
❑ preliminary survey of suspected sites ❑ preliminary investigation ❑ main site investigation ❑ remediation	❑ number of sites ❑ polluted surface size ❑ polluted groundwater volume ❑ conclusions of the investigation (classification for the next stage) ❑ number of sites with high and low economic potentials	❑ expenditures in 3 main financial frameworks and private spending itemised in contracts with private parties ❑ the use of remediation goals ❑ the destination of soil becoming available ❑ the use of juridical and financial instruments ❑ spending related to juridicial and financial instruments
❑ report of recent contamination ❑ clean-up of recent contamination	❑ number of sites	

Draft (future) indicators

- Volume of hazardous substances in soil

  This indicator is not included in the Netherlands' national monitoring system. Some data are available from the local government (e.g. information on the contaminated site) but are not included in the database. Since it is too detailed to collect this information for each contaminated site, it would be easier to make an estimate on the basis of soil-polluting activities. The type (of group) of contaminant could be derived on the basis of the activity, making it useful to divide the contaminants into groups of, at least, mobile and immobile contaminants.

  To quantify the extent of the soil contamination in the Netherlands, an inventory of all (industrial) activities that could form potential sources of soil contamination has been initiated. For this, new standard categories for soil-polluting activities have been developed, for example, on the basis of the European standards NACE. These standard categories, the so-called UBI code/index (uniform classification of the sources of polluting activities), are included in the new database system for monitoring (Globis). Linked to this UBI code/index, a model has been developed to assess the group of contaminants and to obtain an initial indication about the urgency of the site investigation.

- Incidences of groundwater/drinking water affected by local soil contamination

  These indicators are not included in the national monitoring system of the Netherlands. Some information on the public drinking-water supply is available from local government but is not entered into the data system at the moment. In principle, the Netherlands is interested in information on the impact of soil contamination. The indicators, as proposed, could form the first step in the monitoring. Here, it is important to cover the public and the private drinking-water supply. However, there is less information on private than on public water supply. Information on costs for extra purification facilities is either impossible or difficult to get.

- Re-used (reclaimed) brownfields in relation to consumed green land

  There is no special information available about this kind of activity or re-development of urban areas. A new indicator is now in the process of being developed. This indicator will give insight into the reasons for stagnation of soil clean-up in some cases and attempt to figure out the link between impediments to land development/re-use (social activities) and the presence of contamination in the soil.

Other suggestions for indicators

Expenditure for each of the different parties responsible (e.g. public, private).

Spain

Antonio Callaba de Roa
Department: National Reference Centre for Soil
Instituto Tecnologico Geominero de Espana (ITGE), Madrid, Spain

One of the main tasks of the IGME (Spanish Geological Survey) as the Spanish NRC for soils is to identify a set of indicators appropriated for assessing the environmental quality of soils. This issue starts from the results obtained in various reports prepared by the Ministry of Public Works, Transport and Environment (Moptma), which began in 1995.

The purpose of establishing an environmental indicator-based system is to provide policy makers and the general public with a simple overview of environmental trends, drawing together complex socioeconomic and environmental factors into a small number of headline indicators. The final purpose of such indicators is to provide a comprehensive image of the environmental phenomena without losing scientific accuracy.

The first approach to this task was to review the structure and content of the principal environmental indicators systems employed by the different countries and international organisations. The OECD indicators classification system was selected as the main guideline to establish the Spanish set of indicators. This method includes several types of environmental indicators, each corresponding to a specific purpose and framework:

— environmental indicators (PSR model), to keep track of environmental progress;
— sectoral indicators, to promote integrating of environmental concerns into sectoral policy-making;
— indicators derived from environmental accounting, to promote both integration of environmental concerns into economic policies and sustainable use and management of natural resources.

To develop the Spanish environmental indicators programme, it was decided to adopt the Environmental Indicators defined according to the above-mentioned classification. The PRS model considers that human activities exert pressures on the environment and affect its quality and the quantity of natural resources (state); society response to these changes through environmental, general economic and sectoral policies and through changes in awareness and behaviour (response).

According to this model, the first proposal of indicators which considered the area of soils was published in 1996 by the Spanish Environment Ministry (MIMAM) ([1]). Following this outline, MIMAM published another report, specific for the areas of water and soil, in 1998 ([2]). The last record of environmental indicators arose from the discussion meeting of the Eionet users that took place in September 2000. In this meeting the number of indicators for contaminated soils was considerably reduced in relation to the former proposals, probably due to operational criteria.

Table 6 reflects the evolution of the proposal for a Spanish environmental indicators system in the area of contaminated soils. The current list of indicators has been completed by the NRCsoils with additional indicators, in order to enrich the information and to ensure a better planning of outcoming activities and budget assignments in a medium/long-term period. Nevertheless, this additional set of indicators has to be discussed with all the interest parties.

Evolution of proposals for national indicators for local soil comtamination in Spain Table 6

Type of indicator	MIMAM, 1996	MIMAM, 1998	September 2000	NRC soils proposal (December 2000)
State	Contaminated sites	Number of contaminated sites	Contaminated sites	Number of contaminated sites
Pressure	—	Use of plaguicides	—	Potentially contaminant activities
				Annual waste reports
				Industrial soil
				Accidents with environmental consequences and accusation of environmental mismanagement/ spillage
				Phytosanitaries use
Response	—	Soil surface protected by conservation programmes Public investment in soil decontamination	—	Long-term investment in soil management (inventories, characterisations and decontamination)
				Companies with an EMS/ environmental insurance
				Annual rate of decontaminated sites

(1) Indicadores ambientales. Una propuesta para España (Environmental indicators. A proposal for Spain) (MIMAM, 1996).
(2) Sistema Español de Indicadores Ambientales: subáreas de agua y suelos (The Spanish System of Environmental Indicators: subareas water and soil) (MIMAM, 1998).

WORKSHOP ON INDICATORS FOR SOIL CONTAMINATION
(Vienna, 18-19 January 2001)

National Reference Centre for Soils
SPAIN

MILESTONE I
Indicadores ambientales. Una propuesta española (1996).

MILESTONE I
Indicadores ambientales. Una propuesta española (1996).

- A general framework for environmental indicators, other than those specifically adressed to polluted soils, is settled
- The OECD indicators classification system (Pressure-State-Response) is adopted.
- Just one indicator (state) is focused on contaminated soils: number of sites included in the National Inventory of Contaminated Sites.

MILESTONE II
Sistema español de indicadores ambientales: Subáreas de agua y suelos (1998).

MILESTONE II
Sistema español de indicadores ambientales: Subáreas de agua y suelos (1998).

- The environmental indicators system is developed for soil and water.
- The initial set of indicators is upgraded to cover diffuse pollution and a response indicator.
- List of indicators under consideration encompass:
  - Number of contaminated sites (state)
  - Pesticides consumption per unit (pressure)
  - Public investment in polluted soils management (response)

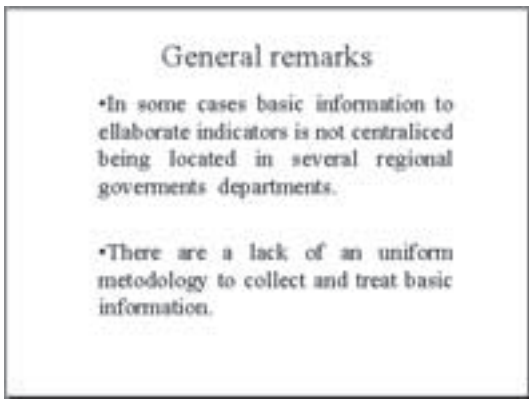
MILESTONE III
Documento de discusión sobre indicadores ambientales para suelos (2000)

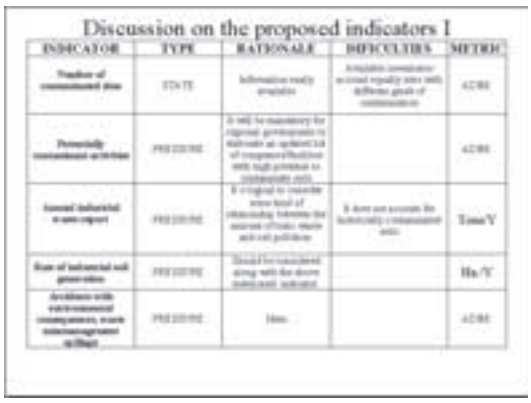
MILESTONE III
Documento de discusión sobre indicadores ambientales para suelos (2000)

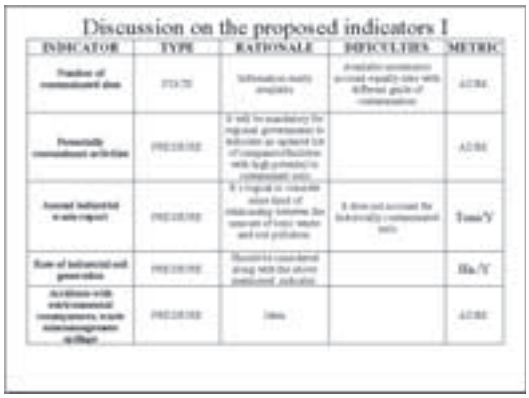
- A draft document on environmental indicators for soils is issued by DECasa in November 2000. It will be discussed with the parties (regional governments representatives, scientific and academic institutions) in a meeting which will take place February 2001.
- It attempt to complete a whole picture of soils by addition of several indicators (pressure and response)

Environmental indicators for soil which will be discussed at national level

	STATE	PRESSURE	RESPONSE
Local soil contamination	Number of contaminated sites	Potentially contaminant activities	Long term investment in contaminated soil management
		Annual industrial waste output	
		Rate of industrial soil generation	Number of companies with EMAS/ISO 14001 certificate or environmental assessment
		Accidents with environmental consequences, mismanagement or spillage	
Diffuse soil contamination	-	Annual pesticides consumption by area unit	-







2.3. Country statements

Austria

As the author of the questionnaire, Austria can provide most of the information regarding the various indicators. It is quite easy to provide the exact or at least estimate the amount of CHC in soil. Whereas the impairment of drinking water supply cannot be stated easily. There is no information on brownfields or greenland consumption. It is attempted to collect these data this year at least in hot spot areas at regional level.

Bulgaria

Contaminated soil is a priority problem in Bulgaria. So far, there is no separate regulation. The Ministry of the Environment runs an information system on pollution, levels of pollution and restriction of land use. A plan exists to develop indicators which should help with the decision regarding measures. The performance of recovery programs for regions is a money problem.

Finland

It is stated that the proposal concerning indicators of local soil contamination has undergone a considerable improvement since the previous presentation. The indicators in themselves allow a fairly good description of the state of soil contamination and of the measures taken to solve the problem.

Although the indicators are correct in general, they will not necessarily give the right picture of the situation in different countries. Data coverage and handling vary from one country to another. If there are differences in the manner the original data has been defined, collected and handled, the indicators are likely to be misleading. Wrong conclusions can be drawn from individual figures. Those proposals that include tables where the background data is presented more extensively, give the decision-makers a better possibility to evaluate the comparability of the results. Much more attention should be paid to the description of the background data, its collecting and handling.

- Indicator: soil polluting activities from localised sources.
  - — The spectrum of soil polluting activities describes in this case more what kind of activities have been inventoried than quality of polluters. Also the classification of contaminated sites varies between countries.
  - — It was not clearly understood what the connection is between the text ‘policy

relevance' and this indicator (most of the observed sites are already polluted).
— If 'key pollutants' to the various activities should be found, more detailed classification of industrial branches would be needed.

- **Indicator: number of sites**
  — It is essential to define terms like sites and sizes before these indicators will be used.
  — In Finland potentially contaminated sites are included in the register. So it is impossible to estimate number or surface of sites per different impact level.

- **Indicator: amount of hazardous substances in soil**
  — It is not easy to estimate amount of substances. Finland could use data from clean-up sites and try to estimate the average amount of substances in different cases.
  — What does amount tell about real impacts of the contamination? To estimate risks we need more information on sites.

- **Indicator: incidence of groundwater impairment at drinking water resources**
  — There are a number of indicators for describing the impact of contaminated soil on water supplies, on aquifers in particular. In Finland there are about 7 000 classified, relatively small aquifers, about 1 500 public drinking-water supply facilities and about one million private drinking-water facilities. It is nearly impossible to collect the proposed data especially for private wells.

- **Indicator: expenditure on remediation activities**
  — It has been written that 'The total clean-up costs are important for the attention paid to this particular matter'. More than the attention expenditures depend on extent of problems.
  — It would be very interesting to know background data of annual expenditures. In Finland it is almost impossible to collect information on expenditures of private clean-up cases. An estimation could be given on public expenditures.

- **Indicator: progress in contaminated sites management**
  — Indicator describes well process of the management of the contaminated sites.
  — In Table 2 available level of achieved impact could be like Germans: mostly, often, rarely, never.

- **Indicator: re-used contaminated land in relation to consumed green land**
  — There are difficulties in collecting data related to the reutilisation of brown areas and green land protection/conservation, as these terms have not been defined or used in collecting land-use data, or in the follow-up of land use in Finland.

France

French legal definition of contaminated sites: 'polluted site representing a significant risk for health or the environment'.

French legal definition of soil: from the surface to the surface-water table.

An inventory exists on former industrial sites and service activities that could be a source of pollution. This database called Basias (http://basias.brgm.fr) is managed by BRGM in accordance with the Ministry of Land Planning and the Environment (MATE). So far, 30 000 sites are registered, not all of them are contaminated. The progress of the collected data varies in the different departments.

Basias-IHR:
Regional Historic Inventory
BRGM draws up the systematic inventory
Inventory carried out for each French *département.*

Regional historic inventory of industrial sites
Objectives:
— collect information on former industrial sites;
— preserve the memory of industrial sites on national data files;
— data will be used with a Geographical Information System (X,Y geographical location);
— the obtained information shall be made accessible to the general public;
— give information to the planning decision-makers.

Principle uses of the information stored in the database Basias:
— protection of human health
— protection of the environment
— prevention previous to new planning projects
— exploitation of the data with a geographical information system to produce decision guide documents.

In the database Basias-BASOL the actual polluted sites are registered.

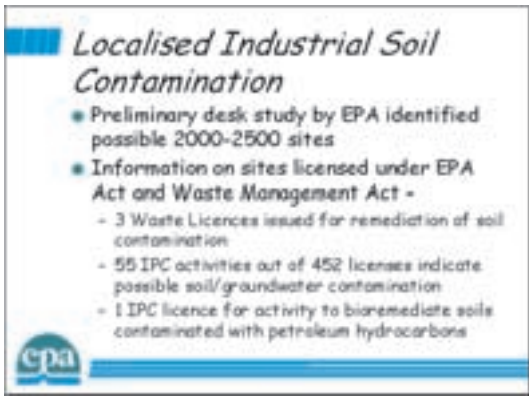
Germany
- Soil polluting activities:
  data already existing
- Number of sites:
  numbers of test sites and at country level available but problem to provide nation-wide information
- Amount of hazardous subst.:
  no data on national level, could require data from test regions
- Groundwater and drinking water:
  no data on national level, could require data from test regions
- Expenditures:
  problem since the polluter pays principle is applied, therefore not all of the data are obtained, little information of the 'Länder', but not on national level, no information on private activities
- Progress in contaminated site management:
  OK, data could be provided in a short time
- Brownfield:
  this subject should be gone further on, suggestion to justify it, e.g. redeveloped brownfield areas/number

Greece
In Greece, no survey exists to identify contaminated sites. Only suspect areas can be identified. Some random surveys are done at the moment for industrial sites but no collection of data. Monitoring is only undertaken for forest conditions. At the moment, the nitrate problem is tackled and a survey about how the individual municipality is handling their waste. Identification of some contaminated sites through this survey is possible.

Iceland
Iceland is a sparsely populated and hardly industrialised country. Problems with soil erosion and with local soil contamination, e.g. land filling, open bit burning, handling of hazardous substances, are dealt with. Only a few sites are investigated so far, the expected most polluted ones with impact level 2 and 3 where immediate action is needed. But not much work has been put into this field up to now.

More attention has to be directed to finding out where further work is necessary. So far, the following information can be provided: number of sites and progress in management. No information is available for: hazardous substances in soil, re-used land, expenditures. Indicator on groundwater impairment is estimated to be important for further development.

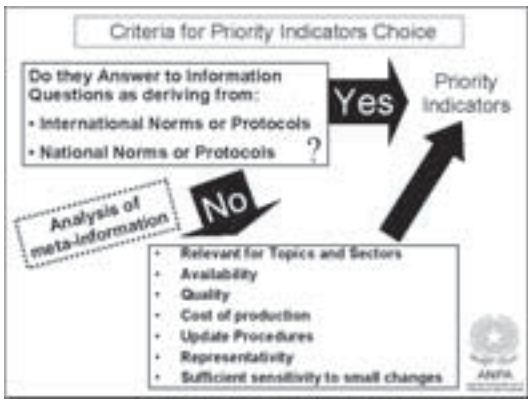
Ireland
In Ireland contaminated soil is no priority area and more attention is directed on diffuse contamination. Therefore only preliminary survey exists for local soil contamination. A desktop survey revealed that there are about 2 000–2 500 sites estimated.

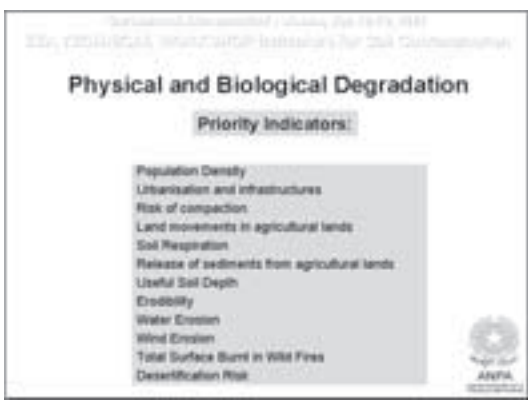


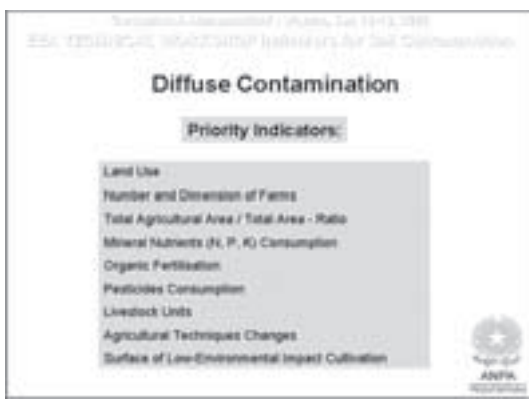
Italy

Italy has established National Topic Centres, similar to the European Topic Centres.

Regarding the questionnaire on local soil contamination the problem is that data is only available for a few regions. In a few months though the situation might improve though the streamlining of data collections.







Norway
Norway has been running a database for 10 years. In the beginning this database was much too detailed and therefore difficult to update. Now the database is being revised and simplified. The EEA approach is considered to be relevant for national purposes and EEA requests are being tackled. The online computer access to the database including geographical information would be available by Summer 2001.

Therefore most of the requested data can be delivered or estimated. Concerning the proposed indicators more effort should be put on:

— soil polluting activity from localised sources;
— industrial brownfields;
— number of sites: all three parameters are useful and can be provided (size and impact level); Norway uses three impact levels;
— amount of hazardous substances: data cannot be given;
— groundwater and drinking water impairment: in Norway only 15 % of the groundwater is used, contaminated sites mainly on shores and river deltas therefore there are no conflicts;
— expenditures: no data since the polluter pays principle is utilised, but estimations can be given;
— progress in contaminated sites management: a very important indicator;
— re-used brownfields in relation to consumed green land: brownfields in Norway are mainly in the cities.

Poland
Poland holds a well developed soil survey which includes among others the content of heavy metals, sulphur, pH values and groundwater composition.

Portugal
In Portugal, local soil contamination related problems are concerned to industrial non-sustainable development, improper waste disposal and incorrect handling and storage of hazardous substances. However, it is expected that the decrease of the problems will mainly be coming from industry and from improper waste disposal.

Concerning legislation, as there is no Portuguese specific legislation or directives from European Union on contaminated soil, the assessment of the existing situations have been based on national general environmental laws and legal documents on water, waste, environmental impacts, among others and proceedings from other countries.

Concerning the reviewed versions of the indicators for local soil contamination, Portugal believes that they are very important for the formation and development of more complex indicators related with this kind of problems. Therefore they seem to be quite suitable and convenient for a good policy of relevant indicators.

However, in Portugal, most of these indicators are only available for punctual situations, but Portugal has some work on 'number of sites' and 'pollutant activities'. The methodologies, criterions and proceedings Portugal has been using are the ones in force in other countries, as the Canadian criterions and the proceedings from the EPA (United States), usually for the assessment of soil and groundwater contamination and for the establishment of remediation actions. These were adopted since they hold the particularity of taking into account the soil and water use in the future linked with a risk analysis to human health and the ecosystems.

Slovak Republic
In the Slovak Republic an information system has been established. It is divided into systems, thereof one of its monitoring systems is soil with quite a lot of information but more in the field of diffuse contamination and less concerning local contamination (nine exist in dangerous regions). So far, focus is laid on potentially contaminated sites, but no inventory exists up to now. Slovakia is now working on the first catalogue of environmental indicators — State of the Environment report and trying to create some structure of the indicators following the DPSIR.

Switzerland
Switzerland consists of several regional cantons, data flow to the government not always granted. Available is the number of polluted/remediated sites. Data concerning the expenditures are not easily available.

United Kingdom

Progress within the UK
- New legislation on contaminated land has been enacted which is
  — now implemented in England and Scotland
  — soon in Wales
  — no plans for Northern Ireland
  The legislation requires state of contaminated land report (only level 3)
- Research has been initiated to develop indicators for contaminated sites (level 2, maybe level 1).

Thoughts on the proposed indicators — recommendations
- Too many indicators altogether, concentrate on three or four only.
- Potentially useful to develop further:
  — soil polluting activities
  — number of sites
  — expenditure on remediation of sites
  — progress in contaminated site management, i.e. how many sites have been remediated to an acceptable use.
  The United Kingdom should have some data in one to two years, since there are several initiatives (e.g. new legislation) that should help to improve the national information on contaminated sites and the progress of their remediation.
- less useful indicators for policy:
  — hazardous substances in soil
  — groundwater impairment
  — water supply impairment
  unlikely to collect this data for soil purposes in the United Kingdom.
- Not sure:
  — re-used contaminated land / greenfield lost
  The United Kingdom knows about re-used brown land, but not contaminated land

Questionnaire
Little of the asked data are available now, more will be available from 1–2 years.

3. Indicators for soil contamination from diffuse sources

3.1. Proposal for the development of policy relevant indicators for diffuse soil contamination

Sigbert Huber and Alexandra Freudenschuss, Federal Environment Agency, Vienna, Austria

Definition and description of diffuse soil contamination
'Diffuse soil contamination' is generally caused by contaminants transported over wide areas, often far from the source. It includes heavy metals, acidification, nutrient surplus (eutrophication), etc. (EEA, 2000).

Diffuse contamination affects the soil functions most in its buffering, filtering and transforming capacity. Currently the most important problems in Europe posed by diffuse contamination are soil acidification, soil contamination by heavy metals and chemicals, and surplus of nutrients. Areas in Europe with high probability of diffuse soil contamination and areas where actual contamination has been reported are given in the report 'Down to earth: soil degradation and sustainable development in Europe' (EEA, 2000).

Assessment of soil contamination
The main objective of the assessment of soil contamination is the reporting on state and changes of soil conditions, based on the development of relevant indicators, gained through comparable, targeted and reliable data sets from harmonised soil monitoring networks and other data sources.

The most important aspects are:

- comparability of data
- representativity of data
- political relevance of indicators.

Development of indicators
The development of indicators is a long-term process. It is a stepwise process, respecting gained experiences of the previous steps for planning of the next steps.

The following points describe the process of indicator development and assessment in its main parts:

- identification of relevant indicators
- identification of data needs
- gathering of required data → data flow
- checking of data (quality, comparability)
- calculation of indicators → assessment
- validation of achieved results
- comparison with reference values.

As shown in Figure 6 further activities in the long-term approach for indicator development on diffuse soil contamination have to consider important impacts on the selection of indicators like policy relevance, data availability and data quality. A very important tool for the identification and the development of relevant indicators is the DPSIR framework applied to diffuse soil contamination.

Selection of suitable indicators and proposed priority indicators
The process of selecting suitable indicators is an iterative process (Figure 7), starting with the identification of indicators based on the DPSIR framework. The first output is an initial list of possible indicators. Related to diffuse soil contamination a first tentative list was included in the proposal for a European Soil Monitoring and Assessment Framework. Considering the frame conditions for developing indicators this list has been revised and an additional list of possible indicators has been elaborated (Figure 8). Both lists, containing existing indicators (Figure 9) and new indicators (Figure 10), were screened for proposing priority indicators (in bold letters) in order to provide a hierarchical list of relevant indicators.

The proposed new priority indicators are listed in Figure 11 and their feasibility and relevance for diffuse soil contamination constituted one of the main subjects for discussion at this workshop.

In a first approach towards results some of the proposed new indicators were presented for Austria (see Figure 12, 13, 14).

According to the feedback on the proposed relevant indicators obtained at this workshop an assessment of data needs is necessary to estimate the data gaps by analysing the available data. This assessment gives a feedback to the selection of suitable indicators and leads at the end of the process to a final list of suitable indicators (Figure 7).

Further steps
According to the discussion of the proposed indicators at this workshop the next steps will be:

- agreement on priority indicators
- hierarchical list of relevant indicators
- questionnaires on data needs and data availability
- analysis of received questionnaires
- preparation of a report on data needs and data availability.

The following steps will be activities of the new ETC on Terrestrial Environment:

- preparation of a data request
- checking of data comparability, quality and format
- preparation of indicator fact sheets.

The main objective of this work is to provide support to the EEA for the Environmental Signals report 2002 (Kiev Report).

Figure 6

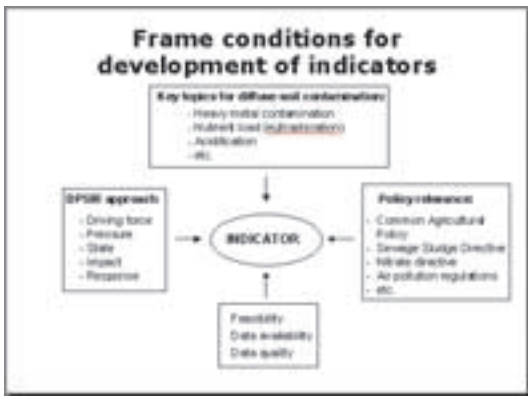


Figure 7

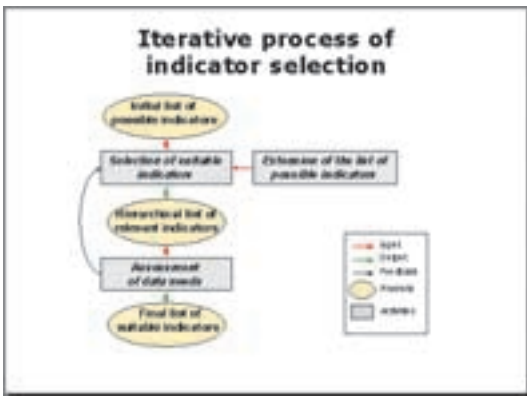


Figure 8

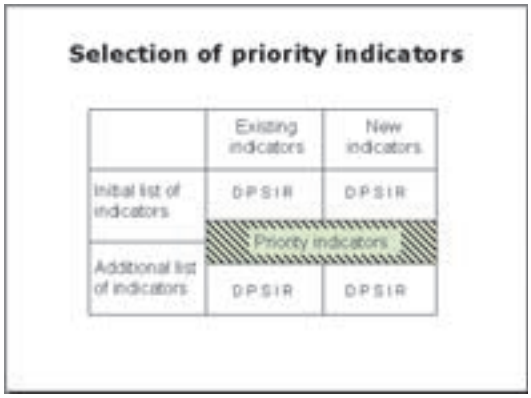


Figure 9

Figure 10

Figure 11

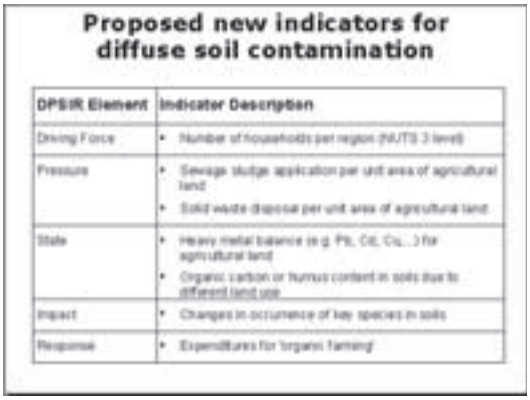


Figure 12

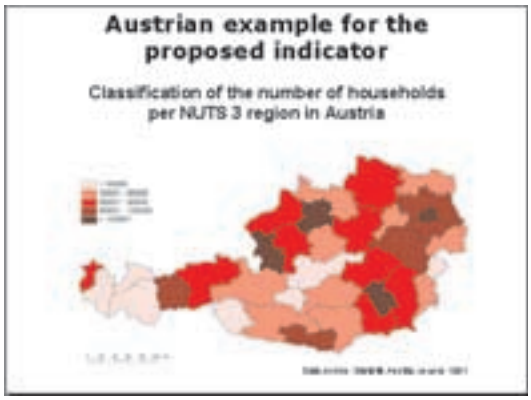


Figure 13

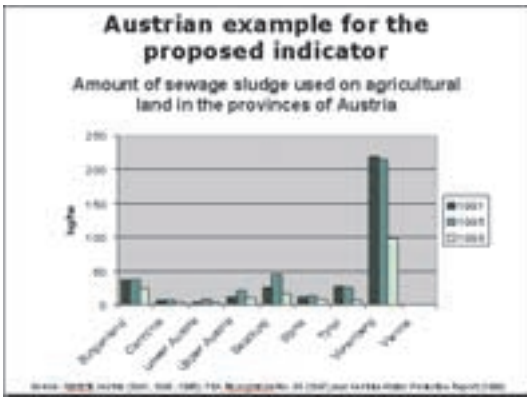
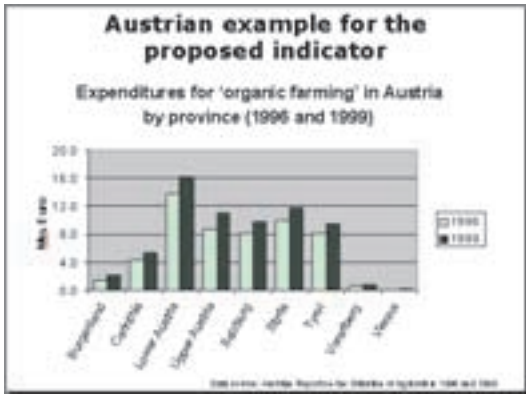


Figure 14



3.2. Country sessions — feedback on the proposed indicators for diffuse soil contamination

The representatives of the following countries were asked before the workshop to give a presentation as a feedback on the proposed indicators for diffuse soil contamination. As these presentations contain also their country statement, these countries are not further listed in the next session.

Denmark
Vibeke Ernstsen, Geological Survey of Denmark and Greenland, Denmark

General remarks and critical points:
- proposed indicators (from the initial list plus new indicators):
  statements see below
- many indicators refer to the type A indicators (What is happening?). Only a few are of the type B indicators (Does it matter?).
- policy relevance?: Not all indicators are regarded as relevant.
- are these the indicators we need? How many of them? Only a few have to be selected.
- data accessibility has to be clarified.
- time frame: a short-term set of indicators (based on existing data) and a long-term set are needed.

Statements on the availability of the proposed indicators
Driving force indicators:

- *No of households per region:*
  Annual reporting on county level

Pressure indicators:
- *Lead emission due to exhaust gas by road vehicles:*
  Not available
- *Use of pesticides in special crops:*
  Annual reporting on national level
- *Sewage sludge application per unit area of agricultural land:*
  Annual reporting at national level in percentage of treated areas
- *Solid waste disposal per unit area of agricultural land:*
  Not used
- *Consumption on fuel oil and gas for domestic use:*
  Annual reporting at national level
- *Emission records due to industrial and waste burning activities:*
  Annual reporting on national level

State indicators:

- *Exeedances of critical loads of heavy metal content in soil related to different land use:*
  In this field the data request should also comprise the definition of critical loads or limits. The content of heavy metals is mapped on national level in a grid system and for some metals (e.g. Cu, Zn) repeated investigations have been carried out.
- *Exceedances of critical loads of heavy metal deposition on soils related to different land use:*
  These might be calculated on a national level.
- *Deposition rates of heavy metals:*
  There exists an annual reporting on the national bulk deposition rate measured at seven places in Denmark.
- *Heavy metal balance (e.g. Pb, Cd, Cu) for agricultural land:*
  The knowledge of the required data sets (when existing) is almost too vague to calculate the proposed indicator. The output of this indicator is not clear.
- *Soil eutrophication (C/N, C/P) related to different land use:*
  Investigated at national level in a grid system of 7*7 km^2.

- *Base saturation related to different land use:*
  Investigated at national level in a grid system of 7*7 km².
- *pH CaCl2 distribution related to different land use:*
  Investigated at national level in a grid system of 7*7 km².
- *Organic carbon of humus content in top soils related to different land use:*
  This issue should be covered by the forthcoming ESB/JRC-study. A mapping is existent on the national level based on a grid system and on some sites repeated investigations have been carried out.

Impact indicators:

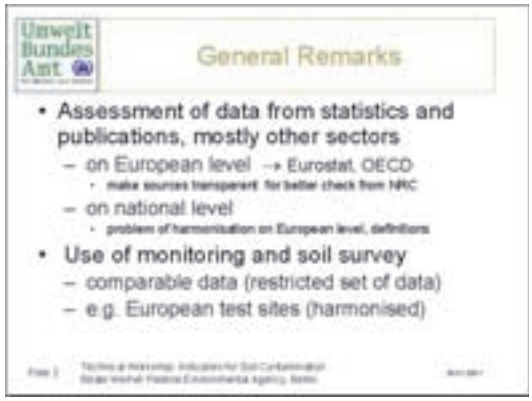
- *Occurrence of key species in soils:*
  Our knowledge about this is rather rough. First few investigations are carried at national level.

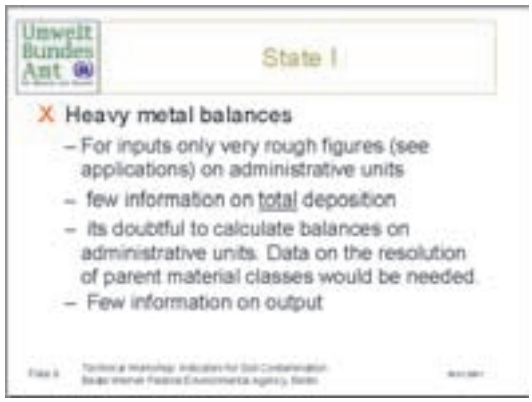
Response indicator:

- *Statutory regulations on emission standards:*
  Meaning as response indicator is not clear.
- Expenditures for 'organic farming' are available on national level.

Germany

Beate Werner, Department: Soil state and Soil use/NRC Soil, Federal Environmental Agency, Berlin, Germany





Netherlands
Hans Bronswijk, National Institute of Public Health and the Environment, The Netherlands

Diffuse soil contamination in the Netherlands
In the Netherlands the following problems exist, but are not yet addressed:

- P-saturation of agricultural soils (widespread, especially in sandy soils)
- acidification/eutrophication of forest soils
- heavy metal accumulation in agricultural soils
- impacts due to pesticides: not yet present but may be in the future.

DPSIR approach
The need for policy-relevant indicators hides the question 'what are policy relevant indicators'?

First of all state indicators (pollutants in the soil) and impact indicators (showing the actual problems on future problems by modelling) shall be developed.

State:
Informs about the content of pollutants in the soil

Impact:
Impact indicators are considered as the most important ones, as they affect the
- decrease of soil bioidiversity
- decrease of forest
- contamination of surface waters
- threats to food quality and crop yield

Pressures:
Application of fertilisers, organic manure, sewage sludge, compost and atmospheric deposition of N, S and heavy metals.

Driving forces:
Population growth, increasing standard of living, export

Responses:
Numerous of them are often indirect, like:
- organic farming
- laws to decrease industrial emission
- laws to decrease fertiliser application
- changes of farmland into forests

and it is difficult to develop direct ones.

Statements to the proposed priority indicators for diffuse soil contamination
Pressure indicators are accepted, additional suggested are:
- fertiliser and manure applications
- industrial and agricultural emissions (or deposition)

State indicators are accepted, additional suggested are:
- heavy metal content (percentage of area where the limit value is exceeded)
- nutrient status (P-content)
- acidity of forest soil (ICP forest).

Impact indicators are also accepted with the following additional suggestions:

- percentage of area where the limit value for food quality is exceeded (available for the Netherlands)
- alternatively to the above one: an estimation of the time left before that limit value is reached
- forest health
- P-contamination of surface waters.

3.3. Country statements

Austria
The Austrian statement is focused on the national data availability of the proposed new priority indicators (see Figure 4.1.6). For the proposed new driving force, pressure and response indicators data are available at the regional level (NUTS 2 or NUTS 3 level). As regards the State indicators the organic carbon content is available for different land use types at regional level. For the calculation of a heavy metal balance for agricultural land the amounts of material containing heavy metals applied to soils are available, the heavy metal content of these materials and the deposition rates of heavy metals on soils can be estimated, whereas the outputs of heavy metals from soils are not available. Regarding the impact indicator changes in occurrence of key species in soils no representative data for Austria are available so far, but several local investigations have been carried out already.

Belgium
Data for the application of sewage sludge and solid waste disposal are available in Belgium at regional level.

The heavy metal balance is a very difficult field to calculate and there are only a few areas where figures could be provided. Similar is the problem related to changes in biodiversity, which is of big interest. Expenditures for organic farming are only available for Flanders. In general the scale is very important and will create difficulties to provide information.

Bulgaria
The most relevant problems in Bulgaria are heavy metals, POPs and acidification. Considering all the proposed indicators the main problem is seen in the comparability of the data. For most of the indicators data are available in Bulgaria.

Finland
Finland consists of approximately 90 % forests (20 % on peat), 7 % agricultural land and 3 % built up areas. The distribution of the 5 million inhabitants is estimated at 3 million in the south, 1.5 million in the middle and 0.5 million in the north of Finland. For this reason different land use types should be a basis for producing maps, in general.

As a new state indicator the ratio of topsoil to subsoil of heavy metal concentrations was introduced and first results were presented to the participants.

The proposed indicators were commented as follows:

- *Driving force indicators:*
  Those related to the development of agriculture are either not seen as a driving force indicator (Area with organic farming as percentage of the total agricultural land) or are not relevant for diffuse contamination (percentage of the utilised agricultural area under agri-environmental measures following Regulation (EEC) No 2078/92). For the consumption of petrol and diesel oil the dimension of kg/km^2 instead of kg/capital is remarked as a better one. The number of household per region is properly the best driving force presented but should be further developed.
- *Pressure indicators:*
  Essentially all the proposed pressure indicators are acceptable, but for the sewage sludge application and the solid waste disposal the development of quality classes is necessary. Data from national databases are available for most of these indicators.
- *State indicators:*
  As for high background values on heavy metals in soil, the proposed state indicator on the heavy metal content in soils is not applicable for Finland. An alternative would be the suggested new indicator mentioned above. The indicators concerning heavy metal deposition are ok. The heavy metal balance is pointed out as a good indicator for the future, but it is not

realistic at the moment due to rough data. For the pH value and the base saturation no standardised values are established at the moment. The organic carbon content is not relevant for diffuse soil contamination.
- *Impact indicators:*
  The occurrence of key species is a good indicator, but only realistic in a long-term approach. Other influences overcovering the influence by contamination have to be considered. Assessment of forest crown condition and content of nutrients in tree foliage are useful.
- *Response indicators:*
  The problem of the comparability of statutory regulations on emission standards is remarked in this case, but the indicators on the expenditures for environmental beneficial farming are feasible.

France
The threats to food quality and the sustainability of the soil functions are named as fields of high priority for indicator development.

At the moment there is no systematic soil monitoring network established in France except the ICP forest network, but the implementation of a national one is planned between 2000 and 2004. An extension of the forest sites to all land use type is intended (grid: 16*16 km^2).

Related to the proposed indicators there are main data gaps for the state and impact indicators but for the driving force, pressure and response indicators data are regarded to be available in the short time.

Greece
Since Greece is not an industrialised country it is concerned with different kinds of problems related to diffuse soil contamination. It has problems with agricultural production, especially fertilisers application. Accordingly most of the proposed indicators are not relevant for Greece. Data for potassium and organic carbon content are available.

Iceland
Soil sealing and soil erosion are the most serious soil problems in Iceland, but there is no real problem with diffuse soil contamination. In general, there is an agreement on the proposed indicators and their relevance, although not all are useable for Iceland. So far, no sewage sludge or solid wastes are applied to agricultural land.

Composts are only used in areas with poor soils and little vegetation. Concerning the heavy metal content a complete data set is available, but it is not of good quality. At the moment no data are available related to the indicator on the humus content and the occurrence of key species. There is also a lack of data among the expenditures for organic farming.

Italy
The statement of Italy is included in Annex I, Section2.

Ireland
Pressures on Irish soils from agriculture are:

- surplus of nutrients (diffuse agricultural input)
- overgrazing of the peatland and upland resources in west of Ireland
- overstocking
- good farming practice:
  — Rural Environmental Protection Scheme implements Council Regulation (EEC) No 2078 of 1992
  — good farming practice, Council Regulation (EC) No 1257/1999
- acidification
- urbanisation, surface sealing

Statements on relevance and importance of the proposed indicators for Ireland were as follows:

- No of households: better No of sheep or cattle;
- application of sewage sludge: not relevant, because not applied at the moment;
- solid waste disposal: not a problem at the moment, data on organic waste are available;
- heavy metal content in soils: does not indicate the real problems on soils;
- organic matter content: constitutes no problem, as 90 % is under grassland;
- occurrence of key species: no data are available and it is unlikely to have information soon;
- expenditures for organic farming: does not say anything about soil conditions.

Norway
Comparable to Finland, soils in Norway show a high background level of heavy metals, so that the proposed state indicator on the heavy metal content in soils is not practicable for Norway. Referring to the deposition rate only the wet deposition is investigated. Data on acidification are not available for

agricultural land. The organic carbon content is only analysed on forest sites and the proposed impact indicator on the occurrence of key species is regarded as difficult to realise.

Data on solid waste disposal and the expenditures for organic farming are not available.

It was remarked with emphasis that the essential point to reduce diffuse contamination is to reduce emission. Therefore response indicators are essential. In general, the priority of indicators has to be discussed.

Poland
For most of the proposed indicators data are not available at the moment. On the large scale it is a problem to estimate the contamination.

Portugal
The main problems of Portugal are the overapplication of fertilisers and pesticides on agricultural land. The national data availability is high for households, fuels and gas consumption. Some information is available on the use of sewage sludge. Few data are available for lead emissions, solid waste disposal, waste burning and expenditures on organic farming. The most serious problems among the proposed indicator are seen in the comparability and the harmonisation of data.

Spain
There were no comments on the proposed indicators for diffuse soil contamination, but a lack of symmetry between local and diffuse soil contamination indicators was remarked (7 indicators for local and 24 indicators for diffuse soil contamination).

Switzerland
The proposed indicators were commented as follows:

- driving force indicator:
  - — number of households per region is of certain importance in relation to spatial planning.
- pressure indicators:
  - — sewage sludge application could make sense, but the problem is the definition of the ratio of sewage sludge applied at one place in relation to other 'fertilisers'.
    Solid waste disposal per unit area of agricultural could make sense too, but how should data be collected and the indicator be calculated?
- state indicators:
  - — heavy metal balance is a good parameter and a monitoring system is in place in Switzerland.Organic carbon content of humus is useless for environmental monitoring.
- Impact indicators:
  - — occurrence of key species: This field is too complex and not directly related to soil protection. Further research work has to be done.
- Response indicators:
  - — expenditures for organic farming is an economical indicator, which does not say much about soil quality issues.

United Kingdom
There are several initiatives underway in the United Kingdom that should improve the availability of information on diffuse soil contamination. These are:

- the development of a national soil protection strategy for England, Scotland and Wales have also undertaken to produce national soil strategies;
- the establishment of a technical panel to assess soil information needs in England and Wales;
- a research project on the 'identification and development of a set of national indicators for soil quality';
- a project on 'monitoring and assessing soil quality' which will reach the end after three years' research.

Comments to the proposed indicators:

There are some potentially useful indicators, although they need a significant amount of development before they can be used. The majority of the remaining proposed indicators appears to be only weakly correlated with diffuse soil contamination or only make up a small part of a particular issue. The indicators, which are recommended for further development are:

- An amalgamation of fertiliser consumption, sewage sludge application and soil waste disposal (or recovery), but also adding in an indicator for the application of animal manure. This indicator would give valuable information about the total additions of nutrients (and possibly other contaminants) to agricultural soil, but would require further development.

- Exceedance of critical loads for the deposition of heavy metals is a logical approach and could make good use of available data. The approach would need further development before it could be applied in the United Kingdom.
- Organic carbon or humus content is important in maintaining soil structure and the ability of soil to filter, buffer and transform pollutants, but more work is needed to understand its importance as an indicator of diffuse soil contamination.
- Occurrence of key species in soil would be an excellent indicator if we knew what the key species were. This should be progressed, but it is likely that an enormous amount of work will be needed before a suitable indicator is ready.

Finally, more work to get the right indicator is suggested. The proposed indicators are not of political relevance in the United Kingdom. In general the consideration of the land use is recommended.

Annex II: Programme

TECHNICAL WORKSHOP
Indicators for soil contamination

Venue:
Gartenhotel. Altmannsdorf/Bruno Kreisky Room
Vienna/Austria
18–19 January 2001

Final agenda

Wednesday, 17 January 2001

19:30–21:00	Welcome reception at the Gartenhotel. Altmannsdorf

Thursday, 18 January 2001

Time	Topic	Speaker
9:00–9:15	Welcome and Opening	Georg Rebernig, Anna Rita Gentile
	EEA indicator-based reporting	Chairperson: Francesca Quercia
9:15–10:00	State of the soil issues in the EEA — relevance of indicator development within the reporting system	Anna Rita Gentile
10:00–10:30	Coffee break	
10:30–11:00	Development of soil indicators as part of a European soil monitoring and assessment framework	Sigbert Huber
11:00–11:30	Local soil contamination — past achievements and future goals	Martin Schamann
11:30–12:00	Discussion	
12:15–13:45	Lunch	
	Local soil contamination indicators	Chair person: Urs Ziegler
13:45–14:30	Presentation of the proposal for the local soil contamination indicators	Martin Schamann
14:30–15:30	Country sessions — feedback on the proposed indicators for local soil contamination	Irene Edelgaard, A. Callaba de Roa, Eddy van Dyck, Esther Sozco
15:30–15:45	Discussion	
15:45–16:15	Coffee break	
16:15–16:30	Opening of a round table discussion: Discussion of a future procedure ...	Urs Ziegler
16:30–17:30	Round table discussion/country statements	
17:30–18:00	Final discussion and close of first day	
19:00–open end	Dinner at the Heurigen 'Zum 5er Pflug' close to the Gartenhotel. Altmannsdorf	

Friday, 19 January 2001

Time	Topic	Speaker
	Diffuse soil contamination indicators	Chair person: Sigrid Schwarz
9:00–9:45	Proposal for the Development of Policy Relevant Indicators for Diffuse Soil Contamination	Sigbert Huber, A. Freudenschuß
9:45–10:15	Coffee break	
10:15–11:30	Country sessions – feedback on the proposed indicators for diffuse soil contamination	Beate Werner, Vibeke Ernstsen, Hans Bronswijk, Carlo Jacomini
11:30–12:00	Discussion	
12:00–13:30	Lunch	
13:30–13:45	Opening of a round table discussion: Discussion of a future procedure	Sigrid Schwarz
13:45–14:45	Round table discussion/country statements	
14:45–15:15	Coffee break	
15:15–16:00	Final discussion and close of meeting	

Annex III: List of participants

Mr(s)	Family name	First name	Institution	Department	Telefone	Fax	E-mail	Street	Town	Country
Mrs	Freudenschuss	Alexandra	Umweltbundesamt Wien	Dept. for Terrestrial Ecology	(43-1) 313 04 36 91	(43-1) 313 04 37 00	Freudenschuss@ubavie.gv.at	Spittelauer Lände 5	A-1090 Wien	Austria
Mr	Huber	Sigbert	Umweltbundesamt Wien	Dept. for Terrestrial Ecology	(43-1) 313 04 36 70	(43-1) 313 04 37 00	Huber@ubavie.gv.at	Spittelauer Lände 5	A-1090 Wien	Austria
Mr	Schamann	Martin	Umweltbundesamt Wien	Dept. for Contaminated Sites	(43-1) 313 04 33 70	(43-1) 13 13 04 32 11	schamann@ubavie.gv.at	Spittelauer Lände 5	A-1090 Wien	Austria
Mrs	Schwarz	Sigrid	Umweltbundesamt Wien	Dept. for Terrestrial Ecology	(43-1) 313 04 36 20	(43-1) 313 04 54 00	schwarz@ubavie.gv.at	Spittelauer Lände 5	A-1090 Wien	Austria
Mrs	Wepner	Martha	Umweltbundesamt Wien	Dept. for Contaminated Sites	(43-1) 313 04 33 90	(43-1) 313 04 32 11	wepner@ubavie.gv.at	Spittelauer Lände 5	A-1090 Wien	Austria
Mr	Carazo-Jimenez	Luis	European Commission, Environment DG, Unit D1	Environment DG D.1 TRMF 3/173	(32-2) 296 00 66	(32) 22 96 88 25	luis.carazo-jimenez@cec.eu.int	200, Rue de la Loi	B-1049 Brussels	Belgium
Mr	Van Dyck	Eddy	OVAM	Soil — remediation	(32) 15 28 44 30	(32) 15 28 44 07	eddy.van.dyck@ovam.be	Kan. de Deckerstraat 22-26	B-2800 Mechelen	Belgium
Mrs	Todorova	Ivanka	Executive Environmental Agency	Land, forest and protected areas	(359) 29 55 98 12		todorova@nfp-bg.eionet.eu.int	136 'Tzar Boris III' Blvd, PO Box 251	1618 Sofia	Bulgaria
Mrs	Edelgaard	Irene	Danish EPA	Soil contamination	(45) 32 66 03 99	(45) 32 66 03 90	ire@mst.dk	Strandgade 29	DK-1401 Copenhagen	Denmark
Mrs	Ernstsen	Vibeke	Geological Survey of Denmark and Greenland		(45) 38 14 29 23	(45) 38 14 20 50	ve@geus.dk	Thoravej 8	DK-2400 København NV	Denmark
Mrs	Gentile	Anna Rita	European Environment Agency		(45) 33 36 72 09	(45) 33 36 71 99	anna.rita.gentile@eea.eu.int	Kongens Nytorv 6	DK-1050 Copenhagen K	Denmark
Mrs	Kylä-Setälä	Annamaija	Suomen ympäristökeskus, Finnish Environment Institute	Pollution Prevention Division	(358) 24 50 37 58	(358) 24 50 37 59	annamaija.kyla-setala@vyh.fi	Valtakatu 6	FI-28100 Pori	Finland
Mrs	Pyy	Outi	Suomen ympäristökeskus	Pollution Prevention Division	(358) 940 30 04 18	(358) 940 30 04 91	outi.pyy@vyh.fi	P.O.Box 140	FI-00251 Helsinki	Finland
Mr	Schmidt-Thomé	Philipp	Geologian tutkimuskesus	T & K Maaperä ja ympäristö	(358) 205 50 21 63	(358) 205 50 12	philipp.schmidt-thome@gsf.fi	Betonimiehenkuja 4 / P.O. Box 96	FIN-02151 Espoo	Finland
Mr	Arrouays	Dominique	INRA-Orleans	Infosol	(33) 238 41 48 02	(33) 238 41 78 69	dominique.arrouays@orleans.inra.fr	Avenue de la Pomme de Pin	F-45160 Ardon	France
Mrs	Nowak	Celine	BRGM	Industrial Environment and Processes Division	(33) 238 64 33 43	(33) 238 64 39 63	c.nowak@brgm.fr	3, Avenue Claude Guillemin	F-45060 Orleans Cedex 2	France
Mrs	Werner	Beate	Umweltbundesamt Berlin	Department Soil Protection Deutsche Kontaktstelle für Boden/Kontaminierte Stoffe	(49) 30 89 03 29 25	(49) 30 89 03 21 03	beate.werner@uba.de	P.O. Box. 330022	D-14191 Berlin	Germany
Mr	Pateras	Dimitrios	Institute of Soil Mapping and Classification		(30) 41 66 05 70/66 05 90	(30) 41 66 05 71	pateras@hol.gr	Theophrastou, 1	GR-41335 Larissa	Greece
Mr	Pétursson	Ólafur	Environment and Food Agency of Iceland		(354) 585 10 00	(354) 568 10 10	olafurp@holver.is	Ármúla 1a	IS-128 Reykjavik	Iceland
Mrs	Brogan	Jane	Environmental Protection Agency	Environmental Management and Planning	(353) 536 06 00	(353) 536 06 99	j.brogan@epa.ie	Johnstown Castle Estate	Co. Wexford	Ireland
Mr	Jacomini	Carlo	Agenzia Nazionale per la Protezione dell' Ambiente (ANPA)	State of the Environment, Controls and Information Systems	(39) 06 50 07 23 76	(39) 06 50 07 22 18	jacomini@anpa.it	Via V. Brancati 48	I-00144 Roma	Italy

Mrs	Quercia	Francesca	Agenzia Nazionale per la Protezione dell' Ambiente (ANPA)	Rischio Technologico e Naturale	(39) 06 50 07 25 10	(39) 650 07 25 31	quercia@anpa.it	Via V. Brancati 48	I-00144 Roma	Italy
Mr	Van Liedekerke	Marc	Joint Reserach Centre of the European Commission	Environment Institute	(39) 03 32 78 51 79	(39) 03 32 78 63 94	marc.van-liedekerke@jrc.it	TP 280	I-21020 Ispra (VA)	Italy
Mr	Bronswijk	Hans J.J.B.	Rijksinstituut voor Volksgezondheid en Milieu		(31) 302 74 38 53	(31) 302 74 44 19	hans.bronswijk@rivm.nl	Antonie van Leeuwenhoeklaan 9, P.O. Box 1	NL-3720 BA Bilthoven	Netherlands
Mrs	Soczo	Esther R.	Rijksinstituut voor Volksgezondheid en Milieu		(31) 302 74 30 65	(31) 302 74 44 19	esther.soczo@rivm.nl	Antonie van Leeuwenhoeklaan 9 P.O. Box 1	NL-3720 BA Bilthoven	Netherlands
Mr	Solberg	Harald	Norwegian Pollution Control Authority (SFT)	Dept. of Local Environment, Contaminated Land and Industry Section	(47) 22 57 35 60	(47) 22 67 67 06	harald.solberg@sft.no	P.O. Box 8100 Dep.	0032 Oslo 1	Norway
Mr	Terelak	Henryk	Institute of Soil Science and Plant Cultivation	Soil Science and Land Protection	(48) 81 88 63 42 13 40	(48) 81 88 66 45 47	arekt@iung.pulawy.pl	Czartoryskich 8	24-100 Putawy	Poland
Mrs	de Jesus Borges	Anabela	Instituto dos Residuos	DPT — Planning and International Issues	(351) 218 42 40 00	(351) 218 42 40 89	anabela.borges@inresiduos.pt	Avenida Gago Coutinho, 30	1000 Lisboa	Portugal
Mrs	Bognarova	Sona	Slovak Environmental Agency	Environ. Policy Dept.	(421) 884 13 52 12	(421) 884 23 03 38	bognar@sazp.sk	Tayovskeho 28	Banska Bystrica 97495	Slovakia
Mr	Callaba de Roa	Antonio	Instituto Tecnologico Geominero de Espana (ITGE)	National Ref. Centre for Soil	(34) 913 49 57 80	(34) 913 49 58 34	a.callaba@itge.mma.es	Rios Rosas, 23	E-28003 Madrid	Spain
Mr	Ziegler	Urs	Bundesamt für Umwelt, Wald und Landschaft (BUWAL)		(41) 313 22 93 38	(41) 313 22 03 70	urs.ziegler@buwal.admin.ch	Laupenstraße 20	CH-3003 Bern	Switzerland
Mr	Lythgo	Malcolm	Environment Agency		(44) 14 54 62 44 17	(44) 14 54 62 40 32	malcolm.lythgo@environment-agency.gov.uk	Rio House Waterside Drive Aztec West Almondsbury	Bristol B532 4 UD	United Kingdom

Annex IV: Results of the workshop evaluation on indicators for soil contamination from local sources

Draft indicator	Importance of indicator (No of red dots)	Data availability of indicator (No of green dots)	Comments
Driving forces/pressures			
Soil polluting activities	14	12	
State			
Number of sites	13	16	Italy: a problem if corresponding to impact level Ireland: based on preliminary desk top study
Amount of hazardous substances in soil	1	1	
Impacts			The Netherlands: 'change in biodiversity' could also be a good indicator for lsc
Groundwater incidents; impairment of drinking water supply	9	9	
Responses			
Expenditures on remediation activities	11	9	
Progress in contaminated site management	13	11	
Brownfields	8	3	

Annex V: Results of the workshop evaluation on indicators for soil contamination from diffuse sources

Issue or question	Proposed indicator	No	Priority class	Import-ance of indicator (no. of red dots)	Feasibil-ity class	Feasibil-ity of indicator (no. of green points)
	Driving forces					
Development of infrastructure, traffic and transport	Consumption of petrol and diesel oil by road vehicles	D1	L	0	L	2
	Road network density	D2	L	0	L	2
Development of agriculture	Area with organic farming (according to Regulation (EEC) No 2092/91) as percentage of the total agricultural area	D3	L	2	M	3
	Percentage of the utilised agricultural area under agri-environmental measures following Regulation (EEC) No 2078/92	D4	M	4	M	3
Development of human population	No of households per region (NUTS 3 level)	D5	M	3	H	13
	Aquifer salinisation	D6	L	0	L	0
	Pressures					
Influence of infrastructure, traffic and transport	Lead emission due to exhaust gas by road vehicles	P1	M	4	M	3
Intensity of agriculture	Livestock units per unit area of agricultural land	P2	M	3	M	4
	Average pesticide consumption per unit area of agricultural land	P3	H	8	L	2
	Use of pesticides (active ingredients) in special crops (e.g. permanent crops, sugar-beet, vegetable)	P4	L	0	L	2
	Fertiliser consumption per unit area of agricultural land	P5	M	4	M	5
	Sewage sludge application per unit area of agricultural land	P6	H	8	H	11
	Solid waste disposal per unit area of agricultural land	P7	L	2	L	0
Influences of housing	Consumption on fuel oil and gas for domestic use.	P8	L	1	L	2
Influences of industry and waste management	Emission records due to industrial and waste burning activities	P9	M	3	H	6
	State					
How many sites show trace element contents over nationally used thresholds? (geogenic or anthropological enrichment)	Exceedance of critical loads of heavy metal contents in soils related to different land use (agricultural land, grassland, forests)	S1	H	5	M	4

Issue or question	Proposed indicator	No	Priority class	Import-ance of indicator (no. of red dots)	Feasibil-ity class	Feasibil-ity of indicator (no. of green points)
Which areas show exceedance of critical load of heavy metal deposition?	Exceedance of critical loads of heavy metal deposition on soils related to different land use (agricultural land, grassland, forests)	S2	M	4	L	0
Input of heavy metals due to wet and dry deposition	Deposition rates of heavy metals	S3	L	1	L	1
	Long-term deposition rates of heavy metals estimated by the moss technique	S4	L	0	L	0
Heavy metal contamination of agricultural land	Heavy metal balance (e.g. Pb, Cd, Cu) for agricultural land	S5	H	10	M	3
Nutrient loads (eutrophication) on agricultural soils	N-balance for agricultural land	S6	M	4	M	3
	P-balance in agricultural land	S7	M	3	M	3
To which extent does soil eutrophication occur?	Soil eutrophication (C/N, C/P) related to different land use	S8	M	3	L	0
To which extent does soil acidification occur?	Base saturation related to different land use	S9	L	0	L	2
	pH CaCl2 distribution (to which extent pH-values less than three occur in a region) related to different land use	S10	L	2	L	2
Depletion of humus in soils	Organic carbon or humus content in top soils related to different land use	S11	H	8	M	3
	Relation of heavy metals in topsoils to subsoils	S12	L	2	L	1
	Content of aromatic hydrocarbonates	S13	L	0	L	0
	Heavy metal content on monitoring sites	S14	M	3	M	4
	Impacts					
Changes in biodiversity	Occurrence of key species in soils	I1	H	6	L	2
Changes in forest health	Assessment of forest crown conditions	I2	M	4	M	5
Nutrient supply of forests	Content of nutrients in tree foliage	I3	L	1	M	3
	Crop quality	I4	M	4	L	2
	Eutrophication of surface water	I5	L	1	L	1
	Responses					
What is done to reduce emissions?	Statutory regulations on emission standards	R1	L	1	L	2
How much on support is spent for 'environmental beneficial' farming?	Expenditures for 'organic farming'	R2	L	2	H	6
	Expenditures for agri-environmental measures under Regulation (EEC) 2078/92	R3	L	0	L	1

European Environment Agency

Eionet technical workshop on indicators for soil contamination

Luxembourg: Office for Official Publications of the European Communities

2002 – 60 pp. – 21 x 29.7 cm

ISBN 92-9167-472-9