

***German Federal Government***  
***Soil Protection Report***

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Federal Ministry for the Environment,  
Nature Protection and Nuclear Safety  
Arbeitsgruppe WA I 5  
PO Box 12 06 29  
53048 Bonn  
Germany  
E-mail: [service@bmu.bund.de](mailto:service@bmu.bund.de)  
[www.bmu.de](http://www.bmu.de)

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## Introduction

Soil is the ultimate basis of all human, plant and animal life. It also performs a large share of natural decomposition and chemical conversion processes. It serves as a filter and reservoir in water and chemical cycles, stores energy and material resources, supports agriculture and forestry, and is an archive of natural and cultural history.

Soil is a highly sensitive system that is vulnerable to all forms of human disturbance. Changes usually take place very gradually and are hard to detect. Once it has occurred, degradation can often be remediated only on a geological timescale – if at all. To uphold the principle of sustainability, all future use of the soil must aim to be environmentally compatible to avoid lasting damage. If it is to maintain its ability to serve as an ecological and economic life support system into the future, the demands made on the soil must be kept within its functional capacity.

A comprehensive soil assessment requires sufficiently precise knowledge about soil quality and how it changes over time. There are many reasons why we know far less about soil quality than about the condition of plants, animals, the atmosphere and water. Soil is usually hidden from view. At best, only its surface is partially visible for part of the time, and determining its precise properties requires sophisticated analysis. The many factors involved in soil formation produce great variation in soil properties even in its natural state, and this variation is compounded by the impact of human use through the millennia. Soils have a complex three-dimensional structure that can only be brought to light with great technical effort.

Soil in its totality did not become a focus of environmental protection and policy interest until the 1980s. Large amounts of highly specific soil information are available for isolated areas, and with some effort this information can be analysed in combination with other soil-related data for a soil quality assessment. However, work of this kind is not yet available for the whole of Germany.

Any assessment of soil quality also requires data on pollution build-ups. Raised pollution levels as a result of human settlement have been the subject of extensive study.

Progress has also been made on measuring background levels of anorganic and organic pollutants in order to assess soil contamination. Comparably little is known, on the other hand, about pollutant concentrations – residues of plant protection products, drugs and diverse industrial chemicals – on land under agricultural and horticultural use. Cataloguing of suspect sites is at an advanced stage.

Data on airborne inputs (acidifiers, nutrients and pollutants) are gathered in monitoring programmes run by the Federal Environmental Agency (for example in the German Environmental Specimen Bank) and by the individual Länder and are interpreted to identify critical pollution loads. Current national input levels of pollutants bound to solid matter (sewage sludge, organic waste, compost, manure, etc.) are comparatively difficult to estimate due to the amount of regional variation in the intensity with which such materials are used.

A central monitoring instrument developed in recent years is the nationwide network of long-term soil monitoring sites designated by the Länder and covering a representative cross-section of landscape types, soils, land use profiles and pollution loads. At these sites, soil quality is documented in a comprehensive programme of soil chemistry, soil physics and soil biology studies. Climate data, substance inputs and outputs, and changes in site biocoenosis are measured continuously to assess substance flows. These data are used both to record current soil quality and to predict future changes. When evaluating the results, allowance must be made for the fact that compared with the biosphere, water and air, soil is a slow-responding system in which both positive and negative changes go undetected until long after the event.

A major problem in assessing soil quality is that the available data are gathered at different administrative levels. These data have to be made compatible and processed, fed into soil information systems and interpreted. But it will doubtless be years before a territorially representative overview of soil quality in Germany is available to the extent needed for specific government activities.

It will not be possible to produce a national soil quality report in the near or mid-term future. Many influencing factors require more thorough assessment, and negative ones may require preventive action. Soil protection is a complex, interdisciplinary field, and national soil protection law needs to be better dovetailed with other relevant areas of law so that visible progress can be made by integrating soil protection aspects into other sectoral legislation. Additionally, greater care should be taken in future to ensure that economic policy instruments are more clearly directed towards preventive soil protection. Effective protection of this indispensable resource requires patience from all concerned.

**Parliamentary mandate**

On 26 October 2000, the German Bundestag approved a motion by the Social Democratic Party and Alliance 90/The Greens on Transborder Cooperation to Improve Soil Protection (Bundestags-Drucksache 14/2567); all parliamentary parties with the exception of the Federal Democratic Party voted in favour of the motion. Among other things, the motion mandates the Federal Government:

- “To raise awareness among the public and responsible parties of the importance and the increasing endangerment of the soil in order as soon as possible to attain sustainable use of the soil as a natural resource.”
- “Once in each legislative period, and for the first time no later than in the first quarter of 2002, to submit to the German Bundestag a report on progress made in the field of soil protection.”



## **Development of federal soil protection policy**

All significant factors affecting soil were compiled and evaluated for the first time in the German Federal Government Soil Protection Strategy of 1985, in the Bundestag's tenth legislative period (Bundestags-Drucksache 10/2977). The Government concluded at the time that not enough had been done in the past to protect the soil as a basis of all life. The Government laid down various objectives, including reversing the trend in land use, reducing pollutant inputs, and making soil protection a task area in its own right as a cross-sectional environmental protection activity. The Soil Protection Strategy provided a framework for action to balance the many and varied demands placed on soil, to prevent soil degradation, and to avert long-term risks and hazards. Consultation with the Länder on new federal laws or additions to existing ones aimed to establish the adequacy of legislation to protect the soil.

The Soil Protection Action Plan (Bundestags-Drucksache 11/1625) adopted by Cabinet in 1987 during the Bundestag's eleventh legislative period, highlighted protection of the soil as one of the most important interdisciplinary task areas in environmental policy for the years to come. To attain the objectives laid down in the Soil Protection Strategy, the Action Plan proposed amendments to primary and secondary legislation, new technical rules and regulations, an expansion of existing information resources, and numerous research and development projects. Various items were identified for urgent action, including the rapid establishment of uniform criteria for cataloguing, assessing, monitoring and sampling suspect sites, and methods to assess the risks of, monitor and clean up contaminated sites – former industrial and waste disposal sites – taking into account government requirements.

In its thirteenth legislative period, the German Bundestag enacted the Federal Soil Protection Act (*Bundes-Bodenschutzgesetz* or BBodSchG). In their Coalition Agreement of 20 October 1998, the Social Democratic Party and Alliance 90/The Greens agreed that "In soil conservation, more emphasis must be placed on prevention." The Coalition Agreement also underlines the importance of securing the remediation of contaminated sites.

### **3     Policy instruments**

The Federal Soil Protection Act, the last provisions of which entered into force on 1 March 1999, and the Federal Soil Protection and Contaminated Sites Ordinance, in force since 17 July 1999, replaced the generally formulated soil protection provisions found in various earlier items of sectoral legislation with a body of law specifically concerned with soil protection. Amendments to the Federal Building Code in 1998 also incorporated stricter rules to protect the soil. The detailed provisions of the Federal Soil Protection and Contaminated Sites Ordinance provide public authorities with a wide range of dispositive powers that have played an important role over the last two years, particularly in the remediation of contaminated sites. The need for these more detailed provisions was already apparent at the time the Soil Protection Act was being enacted. Accordingly, the provisions of the Act granting powers to enact secondary legislation entered into force on the day immediately following its publication. The Federal Government issued the urgently needed implementing ordinance under the Soil Protection Act early in the current legislative period.

#### **3.1     Statute law, case law, regulations and standards**

##### **3.1.1     Scope of the Federal Soil Protection Act**

The Federal Soil Protection Act has supplementary effect where other, sectoral legislation does not cover impacts on soil.

The precedential areas of sectoral legislation include:

- Certain provisions of the Closed Substance Cycle and Waste Management Act (*Kreislaufwirtschafts- und Abfallgesetz*).
- Provisions on the carriage of hazardous goods
- Fertilizer and plant protection law
- The Genetic Engineering Act (*Gentechnikgesetz*)
- The Federal Forest Act (*Bundeswaldgesetz*) and Länder forest law
- Land consolidation law
- Construction, modification, maintenance and operation of transport routes and provisions governing traffic and transport
- Construction planning law and building regulations
- Federal mining law
- Federal pollution law

Unless expressly stipulated otherwise, the subsidiarity rule precludes precedential sectoral laws, such as fertilizer and plant protection law, from being supplemented by the Federal Soil Protection Act. Where laws on other topics contain solely general prescriptions (such as ‘protection of public interests’ or ‘prevention of other risks’), however, soil protection law does affect how such provisions are interpreted. In practice, this means that provisions to protect the soil under, say, pollution control law are laid down as part of federal pollution control law but are fleshed out and interpreted with the aid of provisions found in federal soil protection law. Where specific areas are not expressly covered by legislation on other topics, soil protection law is fully applicable. This is the case, for example, with the body of law on transportation of hazardous goods, which directly covers transportation but not the consequences of any accidents. If soil is contaminated as a result of such an accident, soil protection law applies without restriction. The Federal/Länder Working Group on Soil Protection has prepared a series of papers identifying the demarcation lines between soil

protection law and other legislation and publishes these papers on its web site for use by people involved in applying soil protection law.

### **3.1.2 Emerging case law**

#### **3.1.2.1 Federal Constitutional Court**

Germany's Federal Constitutional Court dealt with two complaints relating to alleged infringements of Article 14(1) of the German Basic Law in a decision of 16 February 2000 (1 BvR 242/91 and 315/99). The first complaint involved the DM 1.1 million cost of cleaning up an industrial site where soil and groundwater had become heavily contaminated with chlorinated hydrocarbons used to degrease rabbit skins. The second related to a clay-pigeon range that had left the soil contaminated with lead to a depth of up to 80 cm. The remediation cost was estimated at DM 5.9 million.

The Court first affirmed the owner's liability for the condition of a property, based on the fact that ownership confers control and on the inextricable link between the benefits and obligations of property ownership. Also, cleaning up a contaminated site is often in the owner's private as well as the public interest: remediation usually significantly boosts both market value and the economic benefits of continued ownership.

Liability for the condition of a property may, however, be limited by what can reasonably be expected from an owner by way of risk prevention. This limitation primarily follows from the constitutional rule of 'proportionality'. Some guidance as to the upper limit can be derived from the cost of remediation in relation to the post-remediation market value of the property. If the remediation cost exceeds that value, the owner's interest in continued possession is generally zero. That is, the property is then wholly worthless and useless to its owner. For this reason, a financial burden exceeding this limit may be considered unreasonable if the cause of the risk emanating from the property is natural, lies in the public domain or is due to use by unauthorized third parties. In such cases, an owner who meets all risk containment obligations cannot be expected to bear the full brunt of liability for remediation. The Court also held that it was unreasonable to expect an owner to meet unlimited liability obligations for remediation with assets that are legally and economically unrelated to the site concerned. In this connection, the Court developed individual criteria for the interpretation and application of Article 14(1) of the Basic Law.

The Court's decision is binding on all administrative courts and administrative authorities. It leaves little scope for a legislative response. Accordingly, each case must be examined on its merits to establish whether the decision applies. Incidentally, a similar limitation of liability was contained in Section 25(2) of the Government's original Soil Protection Bill but was voted down at the committee stage (Bundestags-Drucksache 13/6701, p. 14).

#### **3.1.2.2 Administrative court decisions**

In its decision of 16 May 2000, the Federal Administrative Court held that the Government had made exhaustive use of its legislative powers with regard to assigning liability for remediation. The federal legislation takes precedence over Länder laws that go beyond it in extending liability to other parties. The Court thus affirmed the standpoint enshrined in Article 21(1) of the Act, that the Länder may impose supplementary procedural obligations but not supplement the substantive law.

Two noteworthy decisions from higher administrative courts deal with the boundary between soil protection law and landfill law. Münster Higher Administrative Court (case 20 A 1774/99 of 16 November 2000) and Thuringia Higher Administrative Court (case 4 KO 52/97 of 11 July 2001) held that the Federal Soil Protection Act must be applied fully and uniformly to contaminated sites nationwide. Accordingly, the Act must apply in full if after closure of a landfill there is a suspicion of soil degradation or other risks emanating from it.

### **3.1.3 Soil Protection Encumbrances Registration Ordinance**

The Soil Protection Encumbrances Registration Ordinance (*Verordnung über die Eintragung des Bodenschutzlastvermerks*) entered into force simultaneously with the Federal Soil Protection Act. The Ordinance is based on Article 25 of the Act, under which an owner must pay compensation for any gain in value due to soil protection measures undertaken by a public authority. The compensation must be recorded in the land registry as a public encumbrance on the property. Such encumbrances are recorded as follows: ‘Soil Protection Encumbrance: A public encumbrance is recorded against the property in respect of compensation pursuant to Article 25 of the Federal Soil Protection Act.’ By law, a public encumbrance takes precedence over all other rights recorded in the land registry. At the time of writing, too little experience had been gathered by the Länder to report on this topic in greater detail.

### **3.1.4 Federal Soil Protection and Contaminated Sites Ordinance**

The Federal Soil Protection and Contaminated Sites Ordinance (*Bundes-Bodenschutz- und Altlastverordnung* or BBodSchV) is the main statutory instrument for enforcement of soil protection law in Germany. The main body of the Ordinance is limited to thirteen provisions; however, there are substantial annexes setting out the main details for enforcement of soil protection law.

The draft Ordinance submitted by the Federal Government (Bundestags-Drucksache 780/98) was approved by the Bundesrat – the upper house of Germany’s parliament – subject to numerous modifications (Bundesrats-Drucksache 244/99). The Government adopted the changes in full, enabling the Ordinance to be presented on 12 July 1999 and published in the Federal Gazette (BGBl I, p. 1554) on 16 July 1999.

The Federal Soil Protection and Contaminated Sites Ordinance makes use of several powers conferred under the Federal Soil Protection Act:

- The Ordinance covers the investigation and evaluation of suspect sites, contaminated sites and soil degradation, and lays down requirements for sampling, analysis and quality assurance.
- It lays down requirements for hazard prevention by means of decontamination, containment, protection and restriction measures, and supplementary requirements on remediation investigations and remediation plans for certain sites.
- It contains requirements for the prevention of soil degradation.
- Finally, it specifies trigger values, action values, precautionary values and permissible additional pollution loads.

The structure of the Ordinance reflects soil protection considerations in setting out the procedure for investigating and evaluating suspect sites. The competent authorities must investigate signs of soil degradation – for example if pollutants have been handled on a site

for long periods or in significant quantities and the operating, cultivating or processing methods used make it likely that non-negligible quantities of those pollutants have entered the soil. Such signs may also include increased pollutant levels in crop and forage plants at the site or in water coming from it, or significant soil erosion or deposition by water or wind. If the investigations show that there are reasonable grounds to suspect soil degradation, the competent authority can impose further investigations on the party deemed liable for remediation. The Act provides for compensation if further investigation shows the suspicions to have been unfounded.

The results of the exploratory investigations are evaluated under Article 4 of the Ordinance. This evaluation primarily takes place using trigger values laid down in its Annex 2. Trigger values are concentrations that, if exceeded, require individual investigation of the site taking into account the prevailing use of the land in order to identify any soil degradation or site contamination. If investigation shows concentrations to be below the relevant trigger value, the suspicion of soil degradation is deemed unfounded. For the purpose of applying the trigger values, the annex of the Ordinance distinguishes between soil-human health, soil-crop plant and soil-groundwater pathways. Within the soil-human health pathway, a further distinction is made according to land use, between playgrounds, residential areas, parks and recreational facilities, and industrial and commercial land. The land use categories each have different trigger values. Thus the trigger value for lead is 200 mg per kg of dry matter on playgrounds, 400 mg in residential buildings, 1000 mg in parks and recreational facilities, and 2000 mg on industrial and commercial land. Land use also affects the extent to which remediation is deemed necessary. If action values are exceeded, soil degradation is generally deemed to exist or the site deemed to be contaminated.

A further section of the Ordinance deals with prevention. To this end, Annex 2 of the Ordinance specifies precautionary values for metals (cadmium, lead, chromium, copper, mercury, nickel and zinc) and organic substances. The precautionary values do not vary according to land use. Instead, the annex distinguishes between the main types of soil in accordance with the German Pedological Mapping Guide. Precautionary values are based on ecotoxicological thresholds, taking into account ubiquitous and natural background levels.

### **3.1.5 Unsealing of sealed ground**

Article 5 of the Federal Soil Protection Act authorises the Federal Government to issue a statutory ordinance obligating landowners in certain circumstances to unseal sealed ground. Any such obligation must relate to surfaces which have fallen out of use on a permanent basis and whose sealing violates planning law stipulations.

A symposium has been held and a simulation conducted to explore the legal issues brought up by this authorisation. These showed the amount of land coming into question to be so negligible that a statutory ordinance with uniform national effect would currently be neither necessary, appropriate nor reasonable. 'Unsealing' is almost always done so that the unsealed land can be rebuilt. On the other hand, unsealing is often performed in preparation for urban planning improvement schemes. There is a need here for non-legislative recommendations or technical instructions that set out the meaning, purpose and extent of unsealing and can also be used within the framework of other legislation (water, nature conservation and building law).

### **3.1.6 Derivation Standards**

Initial experience with enforcing federal soil protection law since the Federal Soil Protection and Contaminated Sites Ordinance came into force has shown that the Länder urgently need guidance that sets out the requirements of the Act and the Ordinance in a form that practitioners can relate to. On the issue of soil pollutants, the Federal Environment Ministry has issued a set of 'Derivation Standards' (Bundesanzeiger No. 161(a) of 28 August 1999). The publication describes the methods and standards used for deriving trigger and action values under the Federal Soil Protection and Contaminated Sites Ordinance. The Ministry has broken new ground in providing the document, which states in full detail how the values stated in the Ordinance were arrived at. The same derivation methods can thus be used for substances that are not covered by the Ordinance. In a decision of 3 May 2000, Lüneburg Higher Administrative Court held that while other substance classifications can be used when assessing the need for remediation, the stipulated values must accord with the Derivation Standards.

### **3.1.7 Länder procedural regulations**

A number of Länder have made use of their powers to issue procedural regulations supplementing federal soil protection law. These include rules on disclosure and granting access, and provide for the establishment of contaminated site registers, databases, etc. Recent implementing regulations of this kind have been issued by Lower Saxony, North Rhine-Westphalia, Bavaria, Saxony, and Hamburg.

## **3.2 Cooperation between the Federal Government and the Länder**

1991 saw the creation of the Federal/Länder Working Group on Soil Protection (LABO), a committee of the Conference of German Environment Ministers (UMK). LABO comprises the supreme soil protection authorities of the Länder and the Federal Government, who work together to discuss issues within their policy area, develop solutions and make recommendations. An earlier cooperation platform had existed from 1983 in the form of a Special Working Group on Soil Protection Information Resources.

LABO supports the advancement of soil protection activities and soil protection law, and serves as a forum for exchange of experience among the Länder. Its primary task is to ensure uniform enforcement of soil protection law nationwide and to draw up proposals for its further development. LABO advises and undertakes soil-related work on behalf of the UMK and the Conference of Heads of Department of German Environment Ministries (ACK).

The work and activities of LABO are essential to proper uniform enforcement of soil protection law in all German Länder. LABO plays a key part in many issues covered elsewhere in this report.

LABO comprises a steering committee whose twice-yearly meetings coincide with those of the UMK and ACK, plus currently five standing committees:

- Law
- Information Resources
- Soil Protection Planning
- Soil Pollution
- Contaminated Sites

The chairmanship of the steering committee and standing committees rotates biennially among the Länder in alphabetical order.

The thematic focus of LABO's activities is on topical enforcement issues in the Länder ([www.umwelt.bremen.de/buisy/boden/labo/indexlabo.htm](http://www.umwelt.bremen.de/buisy/boden/labo/indexlabo.htm)).

There is naturally cooperation with other Federal/Länder bodies, such as the Länder Working Group on Water (LAWA), the Länder Working Group on Waste (LAGA), the Länder Working Group on Nature Conservation (LANA), the Länder Committee on Mining (LAB) and the Federal/Länder Committee on Soil Research (BLA/Geo).

### **3.3 Scientific advisory support**

#### **3.3.1 Scientific Advisory Council on Soil Protection**

The Scientific Advisory Council on Soil Protection (WBB) was formed in December 1998. The members of the Council, which advises the Federal Environment Ministry, are recognised scientists in the fields of soil science, geology, soil biology, agriculture, human toxicology, ecotoxicology, and water management. Executive management of the WBB lies with the Federal Environmental Agency. The Council's tasks include:

- Assessing, developing and supplementing the science and methods underlying the derivation of precautionary, trigger and action values under the Federal Soil Protection Act.
- Helping bring about consensus on the science underlying the above-mentioned values.
- Making recommendations on scientific assessment of pollutant impacts on soil functions and on the scientific foundations of human biomonitoring with regard to soil pollution.
- Developing soil quality measurement standards for use as decision aids in regional planning.
- Preparing expert opinions on other related issues.

In addition to providing advice on an ongoing basis to the Federal Ministry for the Environment, the Scientific Advisory Council on Soil Protection took part in December 2000 in an expert panel on the role of soil in the BSE crisis, has issued various expert recommendations (for example on improving methods and procedures for leachate forecasting), and moderated a brainstorming workshop on soil protection. In February 2000, the Council presented a report, *Wege zum vorsorgenden Bodenschutz* (Roads to Preventive Soil Protection, downloadable in German from <http://dip.bundestag.de/btd/14/028/1402834.pdf>). The Council is currently working on a memorial publication, *Böden verstehen – die Erde bewahren* (Understanding Soils: Saving the Earth).

#### **3.3.2 Expert Council on Soil Investigations**

The Expert Council on Procedures and Methods for Soil Investigations (FBU) was set up by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety on 14 June 2000 to meet the requirement for a 'selected group of experts' laid down in the Annex to the Federal Soil Protection and Contaminated Sites Ordinance. The Council resides with the Federal Environment Agency.

The task of the Expert Council is to compile knowledge about advanced methods and procedures of established practical suitability for investigations under the Ordinance, and about the application of such methods and procedures.

The work of the Expert Council is carried out in three working groups: Soil Sampling, Methods and Procedures for Quantifying Substances in Soil, and Quality Assurance and Uncertainty in Soil Investigation Methods.

Recommendations are currently being prepared for publication on:

- Characterisation of the equivalence and comparability of methods and procedures in Annex 1 of the Federal Soil Protection and Contaminated Sites Ordinance and, where applicable, for equivalent or comparable methods and procedures.
- Suitability of on-site analysis methods.
- Suitability of quality assurance measures, including proposals for the permissible level of uncertainty for methods and procedures in Annex 1 of the Federal Soil Protection and Contaminated Sites Ordinance.



## **4     Integration with other policy areas**

The relationship between soil protection law and other, sectoral legislation described in Section 3.1.1 highlights the need to better integrate soil-related considerations into various areas of law and to make greater use of financial controls to protect the soil on a sustainable basis. Certain areas of law that are not primarily concerned with soil thus nonetheless affect the protection of this resource.

### **4.1     Reducing land use and promoting sustainable human settlement**

#### **4.1.1     Current situation**

Judicious use of scarce resources, and certainly of non-renewable resources, is one of the golden rules of sustainability. This principle applies especially to land use. Accordingly, reducing land use is a focus of the German Federal Government's sustainability strategy.

In such a densely populated country as Germany, it is particularly important to conserve the land and with it the soil in its ecological role both as a resource and habitat on which human, animal and plant life depend and as a part of natural water and nutrient cycles.

Hardly any other policy area more plainly reveals the complex trade-offs between ecological, economic and social demands than the management of limited land resources and human settlement. Both the fragmentation of the landscape and the growth of built-up and paved land area relative to agricultural and forest land have negative impacts on the environment. Thus, for example, there are conflicts between traffic growth and recreational uses, habitat loss, barrier effects on wildlife species, and the spread of pollutants.

At the same time, it is important to conserve the land in its many roles – for human settlement and recreation, agriculture, forestry, other commercial and public uses, and transport. For example, it is important to provide the population with sufficient, suitable and affordable residential land. Enough land must be made available at reasonable prices for commercial and infrastructural use. Land use options must also be kept open for future generations.

Efficient, environmentally and socially responsible use of the land is a key element of sustainable human settlement. This was among the commitments we made along with other UN member states at the 1996 Habitat II conference.

Land use for human settlement has already been decoupled from general economic growth. Notably, 'land-take' in western Germany fell from up to 114 hectares (ha) per day in the 1970s to 71 ha per day in the early 1990s. Since then, however, the figure has risen again to 89 ha per day. At the time of unification, eastern Germany had a large amount of catch-up demand for transport infrastructure and residential construction. The use of new land must now be significantly reduced nationwide. Land-take for human settlement and transport infrastructure has now risen to about 129 ha per day in Germany as a whole. This trend must be reversed, aiming for 30 ha per day by 2020. The onus is primarily on the Länder and municipalities, who make stipulations on land use in their regional plans and land-use plans.

A figure of 12.3% for human settlement and transport infrastructure as a percentage of the total area of Germany may seem relatively small, but the desire for more living space combined with rising leisure, consumption and mobility aspirations have caused the area

used for living, mobility, leisure and workspace to increase over several decades, with great regional variation in its distribution between urban and rural areas.

In its residential demand forecast to 2015, the Federal Office for Building and Regional Planning anticipates 12.4% growth in demand for residential land over the next 15 years. This growth is primarily attributable to an increase in owner-occupied property, where demand is set to grow by a good 21%, while demand for rented space remains around the 2001 level. However, the increased demand in the owner-occupied sector must be met from a lower daily land-take. It is thus essential that future residential development for owner-occupied use should take place on urban as well as greenfield sites.

It should be borne in mind that there are significant regional variations in demand. In certain regions, the quantity of housing units will also fall due to an emerging surplus. In eastern Germany, demolition of surplus housing has already brought about a reduction in land take-up. In the long run, the anticipated fall in population numbers will also dampen human settlement growth.

Overall, it is evident that making sufficient advance provision for residential land is an essential part of sustainable human settlement. The same applies for public land management policies that leave room for future generations to enjoy positive industrial and commercial growth.

Built-up land should not be equated with 'sealed' land. A significant proportion of built-up land comprises green and open spaces, and includes environmentally sound land use types. Technically, built-up and paved land also includes the extensive compensatory land areas that must be provided for whenever new land is used. What matters most is thus the quality of land use. This creates the leeway needed to reconcile the ecological component of sustainability with economic and social dimensions despite increased use of the land.

Against this background, achieving sustainable human settlement is thus a complex management task that requires a trade-off of interests at all levels of government.

#### **4.1.2 Strategy**

Sustainable human settlement and its effects on land use must be controlled both quantitatively and qualitatively.

The quantitative approach aims to further decouple land take-up from economic growth and gradually to reduce the quantity of sealed land. This directly involves concepts such as space-saving building practices, compact towns and cities, infrastructure bundling, setting aside compensatory land areas, and unsealing land no longer in use. Indirect contributions towards reducing land utilisation come from site redevelopment, more mixed land use, and traffic-reducing development at transport nodes and along transport axes.

Sustainably managing human settlement while reducing the amount of land used also necessitates qualitative improvements in land use. For example, enhancing the living environment in inner cities increases people's readiness to accept city life as an attractive alternative to a house in the country. New building to meet increased demand for housing is acceptable on the urban periphery if it produces ecologically compatible, economically efficient and socially reasonable settlement structures. Suburban developments with single-family and multi-family dwellings, small gardens and large open spaces can be a positive component of sustainable human settlement.

At the same time it is necessary to improve the landscaping and recreational value of open spaces, particularly in urban regions. In rural regions, the conservation of unfragmented open spaces is especially important.

For the above reasons, a combined strategy of quantitative and qualitative land use control is an appropriate means of sustainably managing human settlement in Germany. Necessary as it is to reduce future land use, exclusively restrictive land-use policies would have severe unwanted economic and social impacts. They would not only inhibit economic growth, but also, by causing a shortage of land and hence housing, would crowd out low-income sectors of the population. Regional planning arrangements to protect open spaces must be accompanied by incentives to earmark and rededicate land at suitable sites.

### **4.1.3 Action areas and policy instruments**

To apply the many available policy instruments in a targeted manner, the action areas need to be differentiated along regional lines. The aims are to protect open spaces, to achieve socially, economically and ecologically appropriate and space-efficient development at the urban-rural interface, and to boost the scale and attractiveness of inner-city development.

Regional planning, building and urban development law offers a wide range of policy instruments capable of promoting sustainable human settlement, and many are already in use. In addition to applying and refining regional planning and soil protection law, greater use needs to be made of planning-related market instruments to create incentives for land-efficient settlement. This applies to fiscal law, subsidies for residential building and urban development, regional structural policy, and the transport sector.

#### **4.1.3.1 Protection of open spaces**

Conserving open spaces and their ecological functions is a major challenge, especially in as densely populated a country as Germany. It entails preventing land from being built upon or sealed, and preventing infrastructural projects from fragmenting the landscape.

Natural and semi-natural areas must be conserved wherever possible. Safeguarding and expanding natural and semi-natural areas requires a biotope network. The amended Federal Nature Conservation Act paves the way for a nationwide biotope network that is planned to comprise at least 10% of the country's land stock.

Germany has a sophisticated set of policy instruments to coordinate regional and subregional planning. The Federal and Länder regional planning acts expressly aim to protect open spaces and natural resources.

Building law and nature conservation law work closely together to ensure sparing and careful use of the land nationwide. Under German nature conservation law, any human intervention in nature or the landscape that is deemed unavoidable after weighing all relevant factors must be compensated by nature and landscape conservation measures.

Through the policy instrument of landscape planning, municipalities and regional planning authorities alike are required under the Federal Building Code systematically to incorporate the objectives of nature and landscape conservation into urban land-use planning. The new Federal Nature Conservation Act introduces this instrument nationwide.

Greater use must be made of existing legal provisions such as giving priority to reuse and redevelopment of derelict plots over the use of new land, and the unsealing of land that has permanently fallen out of use. Land use and building in undesignated outlying areas should not be permitted to expand.

Expansion of the transport infrastructure to meet demand has led to a corresponding increase in land use and the ongoing fragmentation of habitats and cultural landscapes. Further impairment of the landscape must be prevented here, for example by developing new infrastructure along existing routes.

#### **4.1.3.2 Human settlement at the urban-rural interface**

As it stands, urban planning law is already designed to prevent human intervention in nature and the landscape, or at least to make good any such intervention in ecological terms. When new building land is developed, other land must be made available and other action taken by way of compensation. Land-use plans must be drawn up subject to the dictates of sparing and careful use of land and soil. Surface sealing must be kept to the minimum. The provisions on building land registries are an important step towards identifying the available reserves of building land and hence for further measures to use such land. Finally, municipalities can order the removal of buildings from or the unsealing of land that has permanently fallen out of use.

The impact of greenfield retail developments on urban locations – and in the long run on the functioning of urban communities as a whole – has now been recognised. The existing policy instruments must not be diluted.

Much still remains to be done in the way of specific measures to promote sustainable human settlement: To date, too much of the external cost of excessive land use has been met out of the public purse and too little borne by developers. There is a lack of economic incentives to change existing practices. Many municipalities, competing to attract enterprise and with an eye to anticipated tax revenues, have so far had no interest in controlling development by imposing conditions on land allocation. If they are suitably framed and account for the interests of local and regional government, not only urban development and residential building subsidies but also fiscal measures can play a key part in creating the economic incentives for low-impact, space-efficient human settlement.

It is nonetheless possible to contrive strategies to reduce demand without constraining economic and housing needs. A number of municipalities have adopted a comprehensive municipal land management system to coordinate activities and measures involving the use of scarce land resources. This requires compilation of a catalogue of available land (building land, infill plots, and derelict, vacant or underused plots) and an evaluation of the current planning status. This helps identify suitable sites to offer investors and improves the use of building land. More municipalities ought to make use of this tool and may require help and guidance in doing so.

There are also isolated instances of municipalities agreeing joint land use policies. This practice deserves more widespread adoption. With increased cooperation between municipalities and coordination at regional level, municipal land use plans are coordinated across local government boundaries, joint preparatory land use plans are drawn up and the foundations are laid for a long-term regional management strategy for publicly held land.

Greater use needs to be made of the powers conferred under the Federal Regional Planning Act to draw up regional preparatory land use plans and to employ contractual agreements for cooperation between municipalities and regions. Expansion of these cooperative activities is an increasingly important part of resource-efficient land management.

The introduction of distance-based tax relief for commuters has placed car and public transport users on an equal footing and promotes a strategy of urban development concentrated around local rail transport stops. However, the progressive structure of the tax relief primarily favours long-distance commuters who travel by car, and this at least partly detracts from the positive effect of this measure on development.

#### **4.1.3.3 Inner-city development**

Active and economic land management and sustainable human settlement favour development in urban centres by means of land rededication and help prevent suburban sprawl. Many regional planning strategies already incorporate, and in some cases have begun implementing, a trend reversal in urban development by prioritising inner-city development over peripheral development. The aim is to dedicate land to new residential and commercial uses primarily in existing urban areas rather than unnecessarily promoting suburbanisation with large new greenfield developments.

Enhancing inner cities has been a special focus of regional planning and urban development activities for many years. There are numerous proposals and initiatives to strengthen inner cities at federal, Länder and municipal level in Germany. In eastern Germany in particular, urban development subsidies have helped save inner cities from further decay and make them more attractive. The recent increase in the grants paid towards improvements to older inner-city residential properties will also help promote urban revitalisation. Generally speaking, grants and tax relief to promote home ownership are an important factor in urban structural development.

Site redevelopment is a key element in reducing the rate of growth in land use. The total area of derelict inner-city sites has grown considerably with structural changes in the economy, and reuse of such sites is becoming widespread. Compared with virgin sites, reused derelict sites are taking an increasing share in total urban residential development and in the quantity of building land made available for commercial development.

Until site redevelopment becomes fully economic in its own right, urban development subsidies must be used as the primary means of encouraging it. Policies to promote residential building must be better integrated with urban development policies to preserve the inner cities and counter suburbanisation. This is an attractive approach when it comes to site redevelopment: rededicating land for residential use directs residential building grants to locations where the reuse of residential land is a priority in urban development. Grants and subsidies can be used to level out the urban land price gradient and to improve the quality of inner-city life so that cities once again offer young families with children a real alternative for buying a first home in place of suburban communities requiring a daily commute. Increasing use is being made of contractual arrangements between public agencies and investors to make land contamination less of a hindrance to site redevelopment.

A review of the land tax system can also help release inner-city building land by creating economic incentives for sustainable urban development, with the emphasis on updating the valuations used for tax assessment. Land taxes are currently assessed on the basis of

obsolete standard values as of 1 January 1935 (eastern Germany) or 1 January 1964 (western Germany).

In the assessment of inheritance and gift tax, these land valuations have already been superseded by more current figures under decisions of the Federal Constitutional Court.

#### **4.2 Model Decree on Policy Regarding Sites with Soil Pollution, Including Contaminated Sites, in Land Use Planning and in the Granting of Planning Applications**

In December 2001, the Conference of German Federal and Länder Building Ministers (ARGEBAU) adopted a Model Decree on Policy Regarding Sites with Soil Pollution, Including Contaminated Sites, in Land Use Planning and in the Granting of Planning Applications. The Model Decree came in response to the serious problems faced by municipalities and federal supervisory agencies alike in processing planning applications for sites that are heavily polluted with environmentally hazardous chemicals. It consolidates various earlier decrees and revises their provisions in line with current building and soil protection law.

Under the subsidiarity rule enshrined in it, the Federal Soil Protection Act only applies to soil degradation and contaminated sites that are not covered by planning law or building regulations. There is thus a clear demarcation line between the two bodies of law. The objectives of soil protection law are to prevent negative impacts on the soil, and to safeguard and restore its functional capacity, which includes averting hazards. Planning law concerns itself with overall urban development planning, in which all factors must be taken into account, including the impacts of soil degradation. Planning law is also the appropriate instrument for reducing future rededication of natural and semi-natural land for residential and commercial development.

The Model Decree takes the concepts used in the Federal Soil Protection Act – and the precautionary, action and trigger values specified therein – and sets them in relation to the concerns of land-use planning and the granting of planning applications. It thus gives planning and building authorities across Germany uniform guidance on how to proceed in cases involving soil pollution. If a site exceeds the soil arsenic limit for residential areas, for example, the municipality can still earmark the site for uses for which the limit is not exceeded, such as a park or a commercial development. This makes it easier for municipalities to rededicate polluted sites without first having to clean them up at great expense, and thus reduces the need to release agricultural land for residential or commercial use.

#### **4.3 Safeguarding the long-term functional capacity of agricultural soils**

At its June 2001 meeting in Potsdam, the joint Conference of Federal and Länder Agriculture and Environment Ministers unanimously called for increased efforts to combat the accumulation of pollutants in soil. The Conference thus advocates policies that are based on the principles of sustainability and aim to safeguard the functional capacity of soils under agricultural use. The only way to achieve this is to prevent pollutants from accumulating on agricultural land. The use of fertilizers adds unwanted pollutants to the soil as well as desirable nutrients. Sewage sludge, for example, contains pollutants that arise during wastewater treatment. Accordingly, a planned amendment to the Fertilizer Ordinance (*Düngemittelverordnung*) will stipulate maximum concentrations for all fertilizers in order

to prevent pollutants from accumulating in agricultural soils; an amended Sewage Sludge Ordinance (*Klärschlammverordnung*) is also planned.

Unless otherwise stipulated elsewhere, the precautionary values laid down in the Federal Soil Protection and Contaminated Sites Ordinance also apply to land cultivation. As the source of pollutants is immaterial to their impact on soil, all types of fertilizer are subject to the same technical standards. The maximum permitted quantity of each pollutant in a given fertilizer is based on the precautionary values for that pollutant, and is measured with reference to the part of the fertilizer that persists in soil.

In a resolution of 26 April 2002, the Bundesrat recorded specific requirements that the Länder wish to see incorporated in future legislation on sewage sludge.

As pollutants can also enter the soil from the air and in precipitation, clean-air policy is another important factor in soil protection.

Besides minimising inputs of pollutants, safeguarding the long-term functional capacity of soil also requires action to maintain soil fertility. This entails adding nutrients as needed and maintaining soil humus content at adequate levels. To this end, these aspects have been incorporated not only into the applicable primary and secondary legislation, but also into good farming practice. In 1999, the then Federal Ministry for Food, Agriculture and Forestry issued its Principles and Recommendations for Good Practice in Agricultural Use of the Soil (published in Bundesanzeiger No. 73 of 20 April 1999).

## **5      Research**

Research has an indispensable role to play in assessing and improving modern approaches to dealing with soil utilisation, sustainable use of the soil, impacts of chemical substances, decomposition and chemical conversion processes in soil, development of indicators and measurement techniques, and establishment of contamination limits and maximum concentrations. We present a number of research areas by way of illustration in the sections that follow.

### **5.1      Pathway-based approach with trigger and action values**

#### **5.1.1      Direct contact pathway: Derivation of action values published for greater transparency**

The material findings of research projects to arrive at trigger values for the soil-human health (direct contact) pathway – both the trigger values stipulated in the Federal Soil Protection and Contaminated Sites Ordinance and other, derived values that serve as indicators for them – have been published in two manuals, *Handbuch toxikologischer Basisdaten und ihrer Bewertung* (Manual of Toxicological Base Data and their Assessment) and *Berechnung von Prüfwerten zur Bewertung von Altlasten* (Computation of Trigger Values for Assessment of Contaminated Sites). Analyses have been published for more than 30 chemicals to date.

Another research area is concerned with setting and updating TRD (tolerable resorbable dose) values for pollutants in the soil-human health (direct contact) pathway.

Further research is being done to compare the bioavailability of selected anorganic soil contaminants with an in-vitro test system, using an animal model to estimate risks of ingesting contaminated soil material. Test systems suitable for use with organic soil contaminants will be validated in future projects.

#### **5.1.2      The soil-plant pathway**

Various research projects are being conducted to derive trigger values for priority organic pollutants in the soil-plant pathway.

Due to a lack of data resources from which to derive trigger values, a study framework first had to be developed to gather empirical data. The result is Transfer, a database using data from joint Länder research programmes and other data holdings at the Federal Environment Agency. The database allows soil concentrations of both anorganic and organic pollutants to be matched up with plant concentrations on the same site, and forms part of BIS, the national soil information system.

The Transfer database combines and integrates stocks of data that have previously been held separately in national and Länder repositories. Efficient data exchange at both Länder and federal level is made possible by new data compatibility standards. This aids the uniform enforcement of soil protection law. Data resources have also been set up to update and amend substance classifications and the precautionary, trigger and action values laid down in the Federal Soil Protection and Contaminated Sites Ordinance.



### **5.1.3 Leachate: The soil-groundwater pathway**

When the Federal Soil Protection and Contaminated Sites Ordinance was enacted, one point of criticism was the lack of a generally accepted procedure for estimating leachate concentrations at a sampling site or at the saturated/unsaturated interface.

In view of this criticism, and of the large number of Länder bodies and other organisations dealing with issues related to leachate prediction, the Federal Government initiated the development of agreed methods suitable for assessing compliance. In 2001, a Leachate Prediction research programme was set up at the Federal Ministry of Education and Research; some €11 million have been made available to develop viable methods for quantitative and legally actionable leachate prediction modelling. As an outcome of interdisciplinary research in 40 individual and networked projects, the Ministry aims to present a proposal that can be adopted as a standard on methods of leachate prediction for the soil/material-groundwater pathway.

### **5.1.4 Habitat function for soil organisms**

The Federal Environment Agency, Federal Ministry of Education and Research, the German Federal Environment Fund (DBU) and the Deutsche Forschungsgemeinschaft (DFG) have conducted some 15 research projects in recent years on the development, evaluation and application of ecotoxicological test techniques to assess the habitat function of soil. Additionally, a conceptual framework has been developed for deriving soil concentrations for the soil-soil organisms pathway. The focus of further research activity in this area is on plausibility testing concentrations derived for soil organisms.

Another research field aims to develop a soil biology quality classification covering forest, pasture and arable sites. As part of this research, expected values are derived for each site and compared with sampled values to assess soil quality.

In October 2001, the Federal Environment Ministry held a seminar on the status of soil research in soil biology, soil-related ecotoxicity and preventive soil protection activities. The event provided an overview of the current state of biological soil protection research and future research needs.

## **5.2 Interactions between soil and environmental media (air and water), and the impact of land use on the condition and functional capacity of soil (soil quality)**

### **5.2.1 Physical soil degradation**

Besides pollutants, the other main cause of soil degradation comprises physical factors.

#### **5.2.1.1 Erosion**

Soil erosion not only causes a loss of fertile soil material (its on-site impact). Displaced soil material and the substances it carries can significantly affect and even harm neighbouring ecosystems and cultural assets, and can also pollute water resources (off-site impacts).

The potential and actual percentage of land affected by erosion is the subject of a series of current federal and Länder research projects. The preliminary findings show that the impacts

and extent of erosion have so far been underestimated. In Brandenburg and Mecklenburg-Western Pomerania, for example, 16% of all land under agricultural use has been degraded by water erosion and 8% by wind erosion. Some 60% of Saxony's 728,000 hectares of agricultural land is significantly under threat. In Thuringia, 36% of agricultural land is at medium to severe risk of erosion.

#### **5.2.1.2 Soil compaction**

Compaction resulting from use of the land eventually impairs the functional capacity of soil by reducing soil space and hence drainage, water storage and aeration.

Findings on good agricultural practice are presented in a working paper by the Association for Technology and Structures in Agriculture (KTBL) entitled *Bodenbearbeitung und Bodenschutz* (Soil Cultivation and Soil Protection, KTBL-Arbeitspapier 266).

In 2001, the Federal Ministry of Consumer Protection, Food and Agriculture (BMVEL) published a set of recommendations drawn up by a joint working group of federal and Länder soil specialists and entitled Good Agricultural Practice for the Prevention of Soil Compaction and Soil Erosion. The recommendations, published as a guide for consultants and practitioners, describes the steps that can be taken to prevent soil compaction and soil erosion along with options for preventive soil protection.

#### **5.2.2 Inputs of pollutants into soils**

The precautionary principle dictates prevention of soil degradation resulting from pollutant inputs. This means reducing, and where possible avoiding, pollutant inputs from the atmosphere and from the direct application of chemicals or chemically contaminated materials onto soil.

A series of research programmes are being conducted to gather data on airborne pollution in and on soils. These include air pollution monitoring networks; work on topics such as acidifying emissions from transport, fossil fuels and agricultural sources; the 'critical loads' approach; and forest environment monitoring.

Studies on airborne organic pollutants in soils and plants are of particular interest in updating trigger values for the soil-plant pathway.

New findings and advances in knowledge have led to the development and refinement of various techniques, some of which have been incorporated into national and international standardisation efforts – for example DIN ISO 11262 on the determination of cyanide and DIN 19730 on the extraction of trace elements (heavy metals) with ammonium nitrate solution. New techniques have been validated, and in-depth research has been conducted on on-site techniques to accelerate soil quality assessment.

Much research has been done on heavy metal contamination in sewage sludge. The findings show that concentrations of heavy metals in sewage sludge are generally declining. Increasingly reliable data have also become available in recent years on the wide range of organic pollutants.

Strategies have been developed to reduce pollutant loads in sewage sludge and other nutrient sources and research has been done into the possibilities and limits of nutrient recovery from

sewage sludge and slurry. Phosphate recovery is particularly important because stocks of phosphates that are low in cadmium will probably be exhausted in the next few decades.

Further research and development is needed as regards territorially representative soil quality assessment, pollutant transfer, and to advance the state of the art.

### **5.2.3 Other pollutant inputs**

#### **5.2.3.1 Occurrence and behaviour of BSE/TSE prions in soils**

An international symposium was held in Bonn on 18 December 2000 at the invitation of the Federal Environment Ministry, to bring together current findings and to identify any knowledge gaps. The main finding was that while the persistence and mobility of prions in soil is not among the main infection pathways, it could not be ruled out entirely.

The Ministry has awarded a research grant to clarify the role of prions in soil. One of the first questions to address is how to detect prions in soils. If the suspicion that BSE pathogens persist in soil is confirmed, further research will be needed into prion transfer, persistence and behaviour in soil. Depending on the outcome, a risk assessment may also be necessary.

#### **5.2.3.2 Veterinary drugs, feed additives, detergents and disinfectants**

Animal husbandry, particularly for meat production, often entails the use of pharmacologically active feed additives ('growth promoters'), veterinary drugs, detergents and disinfectants. At least a portion of these chemicals find their way into organic fertilizers in modified or unmodified form by way of animal excretion and hence, when the fertilizers are spread, into the soil. Not all such chemicals have yet been adequately studied regarding their decomposition and impacts in soil.

The Federal Environment Ministry has awarded a research grant to establish what quantities of these substances are used in livestock farming. For example, research has been done for pharmacologically active substances into the potential input pathways, impacts and environmental behaviour in soil of the indicator substance tetracycline. There are grounds to suspect that significant inputs of tetracycline enter the environment through slurry from factory farming operations, even though tetracycline is a drug whose use is restricted to sick animals.

Detailed research is still needed on the potential environmental harm – ecotoxicological impacts in soil and leaching behaviour – of tetracyclines and many other veterinary drugs. Follow-up studies that are currently underway aim to help fill this gap.

#### **5.2.3.3 Genetically modified organisms (GMOs)**

Potential soil biology impacts relating to genetically modified organisms have so far only received marginal attention as part of controlled-release studies. It is not yet possible to rule out the possibility of modified genetic material or 'new' gene products persisting in soil, affecting soil condition or quality, or being 'transmitted' by soil.

The Federal Environment Ministry has initiated several soil-related projects to investigate these issues. The projects aim to develop the necessary verification and testing methods. So

far, a method has been proposed for identifying the effects of transgenic plants on soil biology; this has yet to be tested in practice.

### **5.3 Information resources relating to soil protection**

A recurring problem ever since the Federal Soil Protection Act and Ordinance were at the preparatory stage has been the availability of basic information on soil quality nationwide. Initially, the only available information often took the form of pedological maps that were not uniform in scale and did not lend themselves to drawing meaningful nationally applicable conclusions about soil physicochemical properties or soil degradation, for example as a result of pollutant inputs or acidification. The federal and Länder activities described in the sections that follow aim to eliminate these information deficits.

#### **5.3.1 German national soil information system (BIS)**

The Federal Environment Agency is currently developing BIS, a national soil information system, under Article 19 of the Federal Soil Protection Act. This new tool will allow rapid quality-controlled gathering, presentation and analysis of information on soil functions, soil quality, soil pollution, and chemical inputs and outputs. The data is being compiled on the basis of an administrative agreement on the exchange of environmental data between the Federal Government and the Länder.

BIS is an umbrella resource for soil-related data at Federal level. It comprises three secondary information systems, each covering a specific area of soil protection:

- FIS Bodenkunde, the soil science information system of the Federal Institute of Geoscience and Natural Resources (BGR)
- ALIS, the Federal Environment Agency's contaminated sites information system
- FIS Bodenschutz, the Federal Environment Agency's information system on soil protection

#### **5.3.2 Long-term soil monitoring**

Long-term soil monitoring comprises the collection of data on soil quality and how it develops and changes over time as a basis for preventive soil protection activities, with the purpose of identifying risks to the soil and predicting future developments.

The long-term soil monitoring network currently encompasses approximately 800 sites that have been set up by the Länder since the mid-1980s. Establishment of the site network and initial sampling are taking place on a continuous basis and are now well advanced in all Länder. Site setup and sampling is done in compliance with nationally agreed guidelines. Numerous Länder reports have already been published. Some Länder, such as Bavaria, have now taken their first repeat samples after between five and ten years. Beginning in 2003, soil samples from representative survey regions will be chemically analysed at the national Environmental Specimen Bank and preserved in permanent cryogenic storage for retrospective study.

The long-term soil monitoring data collected by the Länder are also intended for use at national level. They are currently being integrated and evaluated nationally for this purpose at the Federal Environment Agency.

Nationwide integration of Länder data also provides the Länder with guidance in refining their data collection and analysis methods, revealing the limits and possibilities of standardisation and data conversion. Based on this information, the results of German long-term soil monitoring can also be incorporated into environmental monitoring at European level.

### **5.3.3 Directory of data relating to soil protection and contaminated sites in the Federal/Länder Environmental Data Catalogue (UDK)**

The Environmental Data Catalogue (UDK), developed under a 1996 administrative agreement between the Federal Government and the Länder, is a vital tool enabling Länder environment agencies and federal authorities to find out who holds what environmental data and where. Data relating to soil protection and contaminated sites in the Federal Environment Agency catalogue (UDK-UBA) have been available online since 2001. Information on the conceptual design, content and structure of the ALIS contaminated sites information system and the BIS soil information system can be viewed at [www.umweltdatenkatalog.de](http://www.umweltdatenkatalog.de). The German Environmental Information Network (GEIN) allows users to search all environmental data catalogues, including those accessed from other federal and Länder web sites.

### **5.3.4 Background concentrations of anorganic and organic substances in soil**

Knowledge of the current general state of affairs as regards pollutant concentrations in soil is a decision criterion in enforcement of the Federal Soil Protection Act. The focus here is on dealing with existing soil pollution and restricting additional inputs of pollutants. The Federal Government and the Länder first published background concentrations for topsoils in 1994. These background concentrations have been continuously updated to make them territorially more representative. The Federal/Länder Working Group on Soil Protection (LABO) will be publishing a revised report in spring 2003. For the first time, the report will include background concentrations for subsoils, arrived at by standardised, agreed methods. For greater local differentiation, projects are also being conducted to identify increased background levels due to human settlement and geogenic causes.

### **5.3.5 Soil background concentrations of organic and anorganic substances in the STARS database**

The revised and enlarged Version 3.0 of STARS, a database of toxic and hazardous substances on contaminated sites, was published on CD-ROM in March 2002. STARS makes it possible to search and query the soil background concentrations of organic and anorganic substances published by LABO in 1998. The database contains data on about 1,500 substances. Some 60,000 data entities store information on each substance over several fields of enquiry: physicochemical parameters, environmental behaviour (e.g. decomposition and stability), ecotoxicology, toxicology, any legislation and standards applying to each substance, occupational safety (maximum workplace concentrations, R and S phrases, etc.). STARS also includes the values stipulated in the Federal Soil Protection Ordinance and the toxicological base data used to derive them.

### **5.3.6 Other data resources**

To improve the reliability of conclusions based on them, data are also drawn from elsewhere – for example industry, geology, agricultural statistics, general statistics, and remote sensing systems. Improved analysis depends on the acquisition of new and more up-to-date data resources. This includes the work, coordinated by the Federal Institute of Geoscience and Natural Resources, on preparing a 1:200,000 pedological base map and Pedological Mapping Instructions (*Bodenkundliche Kartieranleitung*, 5th Ed., KA 5).

## **5.4 Soils as a resource in land use**

There is a need to develop methods and strategies for assessing the impacts of specific land uses on soil. In a series of Federal, Länder and municipal research projects, strategies are currently being drawn up for the use of economic and planning instruments in controlling land use and minimising surface sealing.

### **5.4.1 Soil assessment**

Assessing the functional capacity and conservation merit of soils aids in the protection of open spaces and the development of sustainable, ecologically compatible regional planning policies. Soil assessment methods are being tested in numerous research projects run individually or jointly by the Federal Government, the Länder, municipalities and associations. Soil assessment methods have already been incorporated into planning in eastern Germany. In the medium term, universal standards are needed for making planning decisions based on the functional capacity and conservation merit of soils.

### **5.4.2 Designation of protected areas and the Federal Nature Conservation Act provisions on human intervention in nature and landscapes**

Under the Federal Nature Conservation Act (BNatSchG), parts of nature and the landscape can be designated as protected areas. In the Act's introductory principles, soil is listed as a part of nature and the landscape that can be protected in this way.

Within the framework of the Federal Environment Ministry's Environmental Research Plan, a project is currently underway with the following aims:

- to prepare a legal opinion identifying the scope for soil protection in nature conservation law;
- to lay down criteria based on soil protection considerations for taking soils into account when designating protected areas;
- and to characterise and list examples of soils of special conservation merit.

The preliminary findings indicate that there are as yet largely unexploited opportunities for taking rare soils of special merit into account when designating protected areas.

A second project under the Environmental Research Plan was concerned with improving the methodology for incorporating natural functions of soil into procedures to enforce the Federal Nature Conservation Act provisions on human intervention in nature and landscapes. The project developed criteria for predicting soil degradation as a result of human intervention in nature and landscapes, and for deciding preventive action and compensation.

### **5.4.3 Site redevelopment**

Future research should take an interdisciplinary, holistic approach incorporating political strategies and action plans, site reuse and planning, site clearing, technical methods, and economic feasibility.

Accordingly, the European Commission advocates an interdisciplinary network on site redevelopment. Germany will play a major part in this network, providing stimulus for site redevelopment there.

## **5.5 Future research needs**

Research activities for more effective soil protection and sustainable land use have made considerable progress. In the following, we list examples of existing research gaps and new or additional questions to be addressed by future research and development projects.

- Develop and evaluate new analysis, measurement and assessment methods for soils and for other materials that are applied in and on them.
- Determine total deposition of airborne substances on soil using samplers and immunoassays (a technique for revealing immunological reactions).
- Determine the behaviour of priority pollutants in soils.
- Develop test batteries to determine ecotoxicological effects of soil contamination.
- Develop methods for in-situ removal or accelerated conversion of pollutants in diffusely contaminated soils, taking into account knock-on impacts on natural functions of soil.
- Develop techniques and methods to assess the impact on soils of products – primarily construction products – that are used in soil.
- Improve methods and instruments for planning and undertaking groundwater source and plume remediation.
- Define technical remediation objectives for groundwater degradation due to contaminated sites.
- Determine criteria and parameters for characterising natural attenuation properties in the unsaturated soil zone, presenting appropriate techniques and verification and evaluation methods.
- Prepare base data and framework data – e.g. from remote sensing systems, statistics, geology and hydrology – so that it can be used to improve the currency and reliability of information on soil protection.

## **6     Remediation of contaminated sites**

### **6.1    Definition**

A contaminated site as defined in the Federal Soil Protection Act is one that causes soil degradation or is otherwise a hazard to individuals or the general public. The Act defines two types of contaminated site:

- Former waste disposal sites: closed-down waste management installations, and other properties, in or on which waste has been treated, stored or landfilled.
- Former industrial sites: properties that house closed-down installations, and other properties, on which environmentally harmful substances have been handled.

### **6.2    History**

Suspensions arose in the early 1970s that contaminated sites could threaten human health or well-being and harm water, soil, the atmosphere, plants, animals and ecosystems.

As early as 1971, the Federal Government's environment strategy laid down the principle that illegal dumps should be cleaned up as rapidly as possible, and preferably closed down and their sites recultivated.

In its 1974 Environment Report, the German Council of Environmental Advisors (SRU) identified cataloguing, eliminating and preventing impacts of earlier inappropriate dumping as an area for action. In its 1978 Environment Report, the Council coined the term *Altlasten* ('legacy burdens') for contaminated sites with reference to the unknown risks emanating from the 50,000 or so former landfills and illegal dumps that were known at the time.

Several severe cases then followed in the 1980s: in Bielefeld, Barsbüttel and Hamburg, entire housing developments built on top of landfills or contaminated dredged material had to be vacated and demolished. Large landfills in Georgswerder (Hamburg), Gerolsheim (Rhineland-Palatinate) and Münchehagen (Lower Saxony) had to be made safe at great expense due to problems such as dioxin emissions.

In 1984, the Conference of German Environment Ministers asked the Länder Working Group on Waste (LAGA) to draw up proposals for cataloguing, monitoring, investigation and assessing the risks of contaminated sites. LAGA thereupon appointed a committee on former waste disposal sites and other contaminated sites. In 1989, the committee published an information document, Cataloguing, Risk Assessment and Remediation of Contaminated Sites.

In the same year, the Council of Environmental Advisors published *Altlasten*, a special report on contaminated sites in which it identified areas for action then and in the future. The Council noted that pollutant inputs into the soil, subsurface and groundwater at many former industrial and waste disposal sites had long ceased to be in equilibrium with the purification and moderating capabilities of the respective environmental media. The Council called for greater urgency in cataloguing and assessing the risks of former industrial and waste disposal facilities nationwide so that all contaminated sites could be reliably identified and quickly cleaned up.

The Council regarded tackling the problem of contaminated sites as an example of the shift in environmental protection from the sectoral to the integral approach. Even at this early stage, the Council was already of the impression that the entire scope and severity of the



risks posed by contaminated sites had been underestimated. Over and above the spectacular isolated cases that had captured public attention so far, systematic cataloguing and initial assessment of such sites would open up a whole new dimension to the contaminated sites problem. In particular, the Council considered it essential that measures should be taken not only to clean up past environmental transgressions, but also to prevent future contamination.

The Council revisited the topic in 1995 with a new special report, *Altlasten II*. Its reasons for doing so included the need to review and supplement its earlier proposals. New facets also arose from the initial drafts for the Federal Soil Protection Act and Ordinance, changes in the costs of remediation, additional consideration of those affected by contamination, and above all the situation regarding contaminated sites in eastern Germany, which was not included in the earlier report.

Since 1999, how contaminated sites are dealt with has been dominated by the Federal Soil Protection Act and Ordinance. The Act and the deliberations conducted during its drafting have played a major part in changing how the problems of contaminated sites and their remediation are perceived. Civil engineering is no longer the sole remediation option, and approaches based on risk minimisation are becoming more widely accepted.

### 6.3 Quantitative trends

The table below gives a relatively good overview of the cataloguing of suspect sites:

Year	Suspect sites in Germany
1978	50,000 former landfills and illegal dumps (SRU estimate)
1985	30,000 suspect former waste disposal sites, 5,000 suspect former industrial sites (sites catalogued by the Länder)
1987	42,000 catalogued suspect sites
1989	48,000 catalogued suspect sites
1990	29,000 catalogued suspect sites in eastern Germany
1995	170,000 catalogued suspect sites
1997	190,000 catalogued suspect sites
1999	305,000 catalogued suspect sites
2000	360,000 catalogued suspect sites

Note that the number of catalogued suspect sites only partly reflects the scope of the contaminated sites problem:

- Classification as a suspect site does not necessarily mean that detailed investigation and evaluation will identify the site as contaminated and in need of remediation.
- Classification as a contaminated site does not say anything about the scope or cost of any necessary remediation work. The figures on suspect sites take into account neither the size of the area that is contaminated nor the type and extent of the contamination.

At the same time, merely being classified as suspect has a severe impact on a site's usefulness, market value and mortgagability.

Contaminated site registers were compiled and their format and content laid down by the Länder before the federal soil protection legislation came into force. As a result, there are differences in the types of data collected and how they are stored, and this obstructs direct comparison.

At the initiative of the Länder Committee on Contaminated Sites, harmonisation of the data is now in progress.

## **6.4 Current issues**

### **6.4.1 Advances in remediation methods**

Numerous techniques and methods for remediating contaminated sites have been developed in recent years, leading to a high technological standard in this field.

Containment barriers to prevent pollutants from spreading beyond a site are now standard technology. Decontamination techniques are also available, using water extraction and treatment, soil gas extraction and treatment, and soil removal and remediation using thermal, physicochemical and biological treatment methods. These techniques are already in widespread use and are commercially available in Germany.

One research and development focus in remediation technology is cost reduction. Innovative techniques include reactive barriers in the soil that clean contaminated groundwater as it permeates through them. This is more cost-effective than the groundwater extraction and treatment methods usually practised so far.

### **6.4.2 Natural attenuation of pollutants in the subsurface**

The remediation sector has shown growing interest over recent years in making allowance for and exploiting natural subsurface attenuation and retention mechanisms to reduce the effort and hence the cost of assessing and remediating contaminated sites.

The Federal Ministry of Education and Research has initiated a programme of research, KORA (Controlled Natural Retention and Attenuation of Pollutants in Contaminated Soil and Contaminated Groundwater Remediation), to study natural attenuation processes in soil – an important gain in knowledge of the subject.

### **6.4.3 Groundwater remediation**

Experience has shown that it is hard to make predictions about the feasibility, success prospects and suitability of groundwater remediation measures. It is not possible fully and accurately to measure and make allowance for all factors affecting remediation.

A joint Federal/Länder project, Groundwater Remediation Criteria, has been launched to help reach a more objective analysis of the problems involved.

The project will set out the foundations for development of a national strategy for dealing with existing groundwater contamination. It will develop proposals for implementation of the EU Water Framework Directive together with criteria to quantify the protection objectives and levels it stipulates within the scope allowed for case-by-case judgement.

### **6.4.4 Cooperation between the Länder**

In practical enforcement, there is an urgent need for assessment standards for other pollutants besides those listed in the Federal Soil Protection and Contaminated Sites Ordinance. The Federal/Länder Working Group on Soil Protection (LABO) is now working on proposed trigger values and assessment formulae for 43 pollutants and groups of pollutants that are particularly relevant to contaminated sites. The proposals will serve as guidance for the Länder.

A working party of representatives from twelve Länder and the Federal Environment Agency has drawn up guides on quality assurance when dealing with contaminated sites. The main body of this work is a set of technical instructions for investigating contaminated sites. These provide official experts, investigators and the government agencies concerned with a traceable procedure that can be adapted to the circumstances of each case.

### **6.5 A special case: Contaminated site remediation in eastern Germany**

Enormous environmental problems came to light in former East Germany following German unification. Many of its industrial regions were ecological disaster areas with severe soil and groundwater contamination. Besides the large areas contaminated by military activity and uranium mining in Thuringia and Saxony, the worst-affected parts of the country were the centres of the chemicals industry and brown coal mining in the region around Leipzig, Bitterfeld, Halle and Mersburg, copper mining and copper working in the Mansfelder Land region, the Niederlausitz brown coal region, and the coastal reaches of Mecklenburg-Western Pomerania. Huge blights on the landscape in the form of large holes, craters and spoil heaps left over from open-cast mining, large-scale disruption of the hydrological cycle, and former waste disposal sites – particularly from brown coal processing and chemicals facilities – constituted substantial threats to the environment.

From the very beginning, remediating contaminated sites was one of the main problems of soil protection in eastern Germany. It was not only a matter of averting risks and nuisances to people and the environment; contamination was a critical barrier to investment in rebuilding the economy. Even under the old regime, a provision in the East German Environment Framework Act gave exemption from liability for remediation in certain circumstances, with the aim of encouraging private investors to purchase and continue operating previously state-owned sites and facilities.

In December 1992, the German Federal Government and the Länder of former East Germany entered into an administrative agreement on the remediation of contaminated sites. Under the agreement, in most instances where former East German state-owned companies now administered by the Treuhandanstalt (the agency set up after unification to privatise or wind up such companies) had been exempted from liability to clean up contamination on their land, the Federal Government and the Länder shared the remediation cost in a 60:40 ratio. In large projects of special importance, the Federal Government took on a greater financial share (with 75% borne by the Federal Government and 25% by the Länder).

A joint working group on contaminated sites has been convened to speed implementation of the agreement. This group – comprising representatives from the eastern German Länder, the Federal Agency for Special Reunification Tasks (BvS) and the relevant Federal Government ministries – can lay down the scope of Federal Government refinancing obligations in ‘final settlements’ and assign sole responsibility for conducting major projects to the respective Länder as soon as a satisfactory estimate of the remediation costs is available. A number of projects have now been dealt with in this way. A master agreement on the final funding of contaminated sites was entered into with Thuringia in 1999 and with Saxony-Anhalt in 2001. The BvS is currently negotiating with Mecklenburg-Western Pomerania and Saxony.

Final settlements were reached for three large coastal industry projects in Mecklenburg-Western Pomerania in 1996. Negotiations are currently in progress to assign Länder the responsibility for projects subject to the standard (60:40) funding arrangement.

The following were identified as major projects (excluding remediation of brown coal mining sites):

Länder	Major projects	Settlement
Berlin	Spree river industrial region	Final settlement reached on funding of major projects
Mecklenburg-Western Pomerania	Wismar	
	Rostock	
	Stralsund	
Brandenburg	Oranienburg region	Final settlement reached in 2001 on all Federal Government obligations towards Saxony-Anhalt
	City of Brandenburg	
	BASF Schwarzheide AG	
	PCK Schwedt	
Saxony-Anhalt	Bitterfeld-Wolfen	
	Buna	
	Erdöl-Erdgas-Gommern	
	Hydrierwerke Zeitz	Final settlement reached on Saxonia Freiburg project
	Mansfeld AG	
	Magdeburg-Rothensee	
Saxony	SOW Böhlen	
	Saxonia Freiberg	Final settlement reached in 1999 on all Federal Government obligations towards Thuringia
	Lautawerke	
	Dresden-Coschütz/Gittersee	
Thuringia	Kali-Thüringen	
	VVG Rositz	

### **6.5.1 Remediation of radioactive contamination**

The legacies of the former Wismut uranium mining operations in Saxony and Thuringia are among the largest and most intractable contaminated sites in eastern Germany. In the course of German unification, the Federal Government took over responsibility for cleaning up the Wismut sites. The objective of the environmental remediation project, which is financed entirely out of the federal purse, is to restore the environment and living conditions for the population of the affected areas.

The state-owned Wismut GmbH has already completed more than half the necessary remediation work, with some €3.6 billion made available by the Federal Government. Contamination of the environment with radioactive and conventional pollutants has significantly fallen in the affected regions.

Further improvements to the environment are taking place as closure and remediation of the legacies of uranium mining continues. The remainder of the remediation work will essentially be completed in the next eight or ten years. Post-cleanup remedial measures will remain necessary for a long time thereafter (treatment of mine flooding water and leachate, maintenance, and environmental monitoring). The Federal Government, Saxony and Thuringia have begun talks to reach an overall settlement regarding both allocation of responsibility for post-cleanup work and the as yet open question of funding the cleanup of former Wismut sites that are outside the purview of Wismut GmbH.

### **6.5.2 Remediation of brown coal operations**

Large-scale brown coal surface mining and processing in the former East Germany have likewise left behind severe ecological damage. Remediation of these coal extraction legacies in the Central German and Lausitz coalfields began in the form of job-creation schemes immediately after unification, and has continued since 1993 under an administrative agreement on the funding of contaminated sites between the Federal Government and the Länder in which brown coal deposits are found.

Over DM 960 million (€490 million) – including work done under job creation schemes – was spent on cleaning up brown coal sites in 2001; since the brown coal cleanup operation began in 1991, the Federal Government and the Länder have provided funds totalling over DM 11.8 billion (about €6 billion). As a result, over 80% of the basic mining cleanup and more than two thirds of all rehabilitation commitments have now been completed.

The natural groundwater system has been restored over large areas by flooding former open-cast mines. The numerous lakes that result can be used in future as reservoirs and will eventually be of great recreational and leisure value.

Further milestones have been the flooding of what will become Bergheider See in the former Klettwitz-Nord open-cast mining operation and the commencement of flooding at the Grosskayna open-cast site. Following completion of initial cleanup – earth movement, earth compaction, stabilisation of the rock face and recultivation – and installation of water management systems, flooding has already commenced at 25 of the 46 former open-cast mining sites and is complete at two of the larger sites. Rapid flooding also ensures good water quality. Comprehensive planning approval must be obtained under both mining and water law before the lakes can be created and flooded.

The disassembly, scrapping, demolition and disposal operations involved in cleaning up what was initially over a hundred brown coal processing facilities (briquetting factories, power stations and boilerhouses, low-temperature carbonisation plants, cokeries and gas works) are already at an advanced stage. In central Germany, all major work has now been completed. Some thermal processing sites have significant soil and groundwater contamination. These continue to require expensive, lengthy cleanup work using advanced technology. This work is directly supported by an applied research programme funded by the Federal Ministry of Education and Research.

More than 1,200 suspect sites have been catalogued at former open-cast and processing facilities in the central German and Lausitz coalfields. After step-by-step site exploration and preparation of expert reports, most of these have now been secured and cleaned up. At the close of 2001, further action was still needed at around 380 contaminated sites. The focus of the remaining work will be on groundwater remediation.

## **7     The European dimension**

Soil protection is becoming an increasingly important topic at European level in the course of European unification and negotiations with accession candidates. Germany can provide advice and encouragement here with its experience in soil protection legislation and enforcement. Many Central and Eastern European states have widespread soil pollution and problems with contaminated sites. In southern Europe, the most pressing soil protection problem is erosion. The most important soil protection issue in northern Europe is the acidification of forest soils.

### **7.1     Workshop on Soil Protection Policies in the European Union**

An international workshop, Soil Protection Policies in the European Union (EU), was held in Bonn from 9-11 December 1998 at the initiative and by invitation of the Federal Environment Ministry and in cooperation with the EU Commission (DG XI).

Invitations went out to the environment ministries of all EU member states, EU accession candidates in Central and Eastern Europe, Norway and Switzerland. Twenty-three attended, together with representatives from the European Commission (DG XI and XII), the European Environment Agency, and the European Soil Bureau in Ispra, Italy.

The main objective of the workshop was to exchange information about the soil protection policies of the various countries and the European Union.

A further topic was the extent of the need for common soil protection activities at EU level. The subsidiarity principle laid down in the EC Treaty states that the Community takes action only if and in so far as the objectives of the proposed action – for example, ensuring a high level of environmental protection – cannot be sufficiently achieved by the Member States and can therefore, by reason of the scale or effects of the proposed action, be better achieved by the Community.

The statements made at the workshop showed national soil protection policies to vary widely in their main focus and choice of policy instruments. There is no uniform definition of soil. According to the EU Commission, soil pollution (pesticides, nitrates and phosphates, water erosion, acidification, wind erosion, compaction, salinisation and loss of organic material) is an increasing problem in Europe.

As yet the Community does not have a separate policy on soil protection (although work is in progress – see section 7.3, below). Numerous EU policies directly or indirectly serve to protect the soil, including policies on water, farming, forestry, environmental impact assessments, waste management, research (DG XII) and the activities of the European Environment Agency. Examples include the Sewage Sludge Directive, clean air directives, the Nitrates Directive, and various directives on water.

In the view of the Commission's representative, protecting the soil is a highly complex issue that is best addressed with a well-coordinated mix of policy instruments. In particular, with a view to the Common Agricultural Policy, he advocated strong member state support for the environmental elements of Agenda 2000. Soil monitoring efforts in Europe should also be stepped up and placed on a more formal footing. Soil protection policies should be better coordinated (with more sharing of information). An organisational network could be useful in coordinating the various activities. DG XI could act as a 'focal point' in such a network.

The workshop unanimously adopted a final memorandum containing various common positions, principles and objectives relating to soil protection, including the concept of the various soil functions to be protected in the public interest, and common perspectives for future soil protection policies in the European Union.

The most important outcome of the workshop was the establishment of the European Soil Forum to continue the work that had now been begun. The Forum, comprising high-ranking representatives and decisionmakers from the participating European states, is an expression of the common intent of European states to improve efforts to protect and conserve the soil. To this end, its aims include the development of common principles for preventive soil protection.

## **7.2 The European Soil Forum: Review and outlook**

### **7.2.1 First European Soil Forum in Berlin**

The first meeting of the European Soil Forum took place as agreed in November 1999 in Berlin, at the invitation of the Federal Environment Ministry and the European Commission (Environment Directorate-General). High-ranking government officials and scientists from the EU member states, accession candidates, EU executive bodies and Switzerland met with members of the German Bundestag to discuss how the soil protection considerations can be better taken into account in policymaking and everyday activities.

The 90-plus delegates from a total of 22 countries agreed to continue the European Soil Forum as an important platform for cooperation and for exchanging information and experience.

The Forum began by debating to what extent soil protection considerations are or can be incorporated into other policy areas. Delegates reported on the expectations of EU accession candidates, described the principles underlying soil protection strategies, and discussed the consideration of soil protection concerns in agriculture, regional planning, industry and the remediation of contaminated sites.

The speeches and discussions showed there to be numerous ways and possibilities for the various states to take soil protection considerations into account. However, most of the action taken so far comprises individual measures, and further study would be needed before these can be transferred to other regions or even to an expanded European Union as a whole. Delegates stressed that taking soil protection considerations into account is a major interdisciplinary task for the future. It also became clear, however, that (protection) objectives must first be agreed before any steps can be taken towards attaining them. The goal must be to minimise negative factors and prevent irreversible changes.

In addition to defined objectives and measurement parameters, indicators and sampling methods are needed in order to quantify changes in soil quality. Only when they understand the effects of their actions will individuals and policymakers be able to change their conduct accordingly.

The delegates to the Forum agreed that deciding where and how to legislate on soil protection is a secondary issue. The only important issue is that the soil is adequately and effectively protected. As all human activities affect the soil, it makes sense to incorporate soil protection policy into the regulation of each area of activity. Integration of soil



protection considerations into the relevant areas of policy and law appears a matter of urgency and also the most effective option.

To summarise the discussion:

- Separate laws on soil protection are unnecessary to the extent that other policy areas provide such protection.
- There is an urgent need to review activities worldwide – at the level of the United Nations, the Council of Europe, the European Union and individual states – to identify which activities directly or indirectly serve the purposes of soil protection.
- Existing deficits and gaps must be identified and proposals developed to remedy them. The delegates expressly emphasised that in doing so, allowance must be made for regional differences and the subsidiarity principle.

### **7.2.2 Second European Soil Forum**

The Second European Soil Forum was held at the invitation of Italy in October 2001. The European Commission explained in detail its draft thematic strategy. In particular, it described what special importance, in its view, the various threats to the soil have for policy decisionmaking. The threats include erosion, pollution, surface sealing, compaction, organic impoverishment, loss of biodiversity, salinisation, and impairment of the water supply to the soil. It was made clear that these threats cannot be viewed in isolation, and that they often act in combination. It was also clear that most degradation results from human activities and has an international dimension. The Commission will take this into account when drawing up its soil protection strategy. In doing so, it will consider the role of EU policymaking and activities in the member states, in accordance with the subsidiarity principle.

The Forum advocated highlighting the relationship between soil protection and sustainable development and that between soil protection and the scale of land use. The Forum also saw a need to point out that the underlying causes are not equally relevant everywhere because of differences in environmental, economic and social conditions across Europe.

The Forum discussed three main topic areas; the results can be summarised as follows:

Firstly, erosion and desertification:

- There is erosion not only in southern Europe, but to a greater or lesser extent in almost all European countries. Further research is called for.
- Practicable methods to estimate the threat of erosion across the EU will be available in about two years. As the principles have been thoroughly researched and are scientifically well founded, the policy debate can begin now and general requirements can already be laid down.
- Desertification in the Mediterranean region is a growing problem and the main cause is not climate change, but in most cases (inappropriate) human activity.
- Soil degradation is always caused by human activity.
- It is necessary to identify the extent to which the various human activities contribute towards the problems. Solving them often requires simultaneous action on several fronts.

Secondly, organic substances and carbon sequestration:

- Organic matter in soil is a complex system that can moderate and prevent degradation processes.
- It is extremely important for data to be comparable across Europe in order to assess the state of organic matter in soil. There are still considerable difficulties in this regard. There is also a need for a suitable assessment system.
- Agricultural production methods, organic waste and sewage sludge offer ways of increasing the share of organic matter in soil; however, the potential dangers of using organic waste and sewage sludge cannot be ignored.
- New practices such as conservation farming and no-till farming provide ways of increasing the share of organic matter. Further research is needed into carbon sequestration and its significance for European agriculture.

Thirdly, heavy metals:

- Effectively protecting the functions of soil requires decision aids based not only on soil parameters such as concentration levels, but also on indicators such as ecotoxicological criteria. Monitoring should be extended to include soil functions.
- Use of selected indicators can help set priorities for data collection, and to reveal and eliminate gaps and duplication in ongoing monitoring activities. Data should be selected that can be extended to form an early warning system.
- Various stocks of data are available in the member states, but not all are freely and easily accessible. There is thus a need for appraisal, by and with the member states, of how communication with the EU can be improved.

The Third European Soil Forum is being prepared by France.

### **7.3 European Union soil protection policies**

#### **7.3.1 Thematic strategy under the planned Sixth Environment Action Plan**

In January 2001, the EU Commission published its proposals for a Sixth Environment Action Plan, Environment 2010: Our Future, Our Choice. One of the objectives included in the plan is protecting soil from erosion and pollution. The text of the Plan agreed by the European Parliament and Council calls for a thematic strategy on soil protection, addressing the prevention of, *inter alia* pollution, erosion, desertification, land degradation, land-take and hydrogeological risks taking into account regional diversity.

The European Commission is already proceeding in accordance with the approach for thematic strategies laid down in the proposed Sixth Plan (a scientific approach with broad participation). The first step was the Commission's Communication of 16 April 2002, Towards a Thematic Strategy for Soil Protection, the main objective of which – and hence the objective of the future thematic strategy – is that soil protection throughout the EU be achieved more fully and systematically in the coming years.

The Communication thus deals with preventing, among other things, pollution of the soil, erosion, desertification, land degradation, land-take and hydrogeological risks, taking into account regional diversity, including specificities of mountain and arid areas.

As this is the first occasion on which the Commission has addressed soil protection for its own sake, both the approach it takes and its proposals for future action are described in very broad detail. The Communication aims in particular to:

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

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

1. Initiatives, now, in environmental policies
2. Integration in other policies
3. Soil monitoring
4. Future development of new actions based on monitoring results

The draft Communication was published for public comment on the EU web site in November 2001.

On 4 February 2002, the Commission held a stakeholders' consultation (without any in-depth discussion or vote).

A preliminary substantive debate was held at the informal meeting of environment ministers on Mallorca from 24-26 May 2002. The Spanish presidency plans to adopt conclusions at the Environment Council meeting on 24-25 June 2002.

### **7.3.2 Other planned EU action**

The Commission has announced plans to publish a Communication on Environment and Planning and to hold a conference on monitoring, also to be attended by the accession candidates.

## **7.4 Soil Protection Protocol to the Alpine Convention**

The Protocol for the Implementation of the Alpine Convention of 1991 in the Field of Soil Protection was drafted on behalf of the Alpine Conference by a working group under German chairmanship from 1991 to 1998. The working group comprised members from all signatories to the Convention.

The main points of the Soil Protection Protocol are:

- Maintaining the ecological functions and the diversity of Alpine soils.
- Promoting cooperation in soil protection issues at all levels in the Alpine region.
- Restricting the rededication of semi-natural areas.
- Protection from mass earth movements and their impacts.
- Prevention and remediation of soil degradation from tourism.

A bill to implement the treaty and create the constitutional preconditions for ratifying all signed protocols to the Alpine Convention is currently at the negotiation stage in the German Bundestag. The Federal Government aims to complete the ratification process by the end of 2002.

## **7.5 Contaminated sites in Europe**

Remedial soil protection – contaminated sites – is the focus of the Common Forum on Contaminated Land established at a 1994 meeting in Bonn. Among other things, the forum has led to two EU-funded projects, CARACAS and CLARINET. These brought together networks of administrative, academic, consulting and industrial specialists from some 16 European countries to address technological, social and economic aspects of contaminated sites.

Further information: Common Forum on Contaminated Land: <http://www.ovam.be>  
CLARINET: <http://www.clarinet.at>

The Federal Government makes German legislation and experience in the contaminated sites sector internationally available to support and accelerate policymaking in the domain of soil protection. It also provides interested governments with material on Germany's experience with the transformation of former military sites.

## **8 International cooperation**

### **8.1 Soil protection in international conventions**

#### **8.1.1 Convention on Biological Diversity**

The Convention on Biological Diversity (CBD) is based on a broad understanding of biodiversity, which it defines as the variability among living organisms from all sources; this includes diversity within species, between species and of ecosystems. Its declared aims are the conservation and sustainable use of biological diversity and fair and equitable sharing of benefits from the utilisation of genetic resources. Measures to protect and ensure sustainable use of the soil are to be found (via soil biodiversity) directly or indirectly in various CBD work programmes and thematic areas. In the Agricultural Biodiversity work programme, soil biodiversity receives special attention from the specific standpoint of supporting agricultural production systems, and in particular supporting nutrient cycles and natural enemies of crop pests and diseases. At the Sixth Conference of the Parties (Den Haag, 7-19 April 2002), the parties to the conference resolved to set up an International Initiative for the Conservation and Sustainable Use of Soil Biodiversity. This is one of a number of cross-cutting initiatives of relevance to all thematic areas, and focuses on the services provided by soil ecosystems and related socio-economic factors. The FAO and other relevant organisations were called upon to support and coordinate the Initiative.

#### **8.1.2 United Nations Framework Convention on Climate Change**

In accordance with the Framework Convention on Climate Change and the Kyoto Protocol, the German Federal Government is committed to combating global climate change and its effects in the most efficient and sustainable way possible. While the primary aim of both these accords is to reduce greenhouse gas emissions, they also provide incentives to promote the sequestration of carbon in terrestrial ecosystems.

Soils can store considerable quantities of greenhouse gases and their constituents – primarily carbon and methane – and are thus a key part of global greenhouse gas cycles. To counteract any further rise in atmospheric greenhouse gas concentrations and hence in the global mean temperature, the Framework Convention and the Kyoto Protocol provide for ways of promoting the sequestration of additional quantities of carbon, for example in forests and agricultural soils. A further objective is to confine the large quantities of methane trapped in permafrost; otherwise there is a danger that atmospheric warming will allow the methane, itself a greenhouse gas, to escape and so fuel a positive feedback mechanism that would accelerate the warming process.

#### **8.1.3 United Nations Convention to Combat Desertification**

The United Nations Convention to Combat Desertification (UNCCD) of 1994 recognises the fact that arid, semi-arid and dry sub-humid areas together account for a significant proportion (approximately 40%) of the Earth's land area and are the habitat and source of livelihood for a large segment of its population. Desertification is a threat to the economic and physical survival of a significant fraction of the population segment living in such areas, particularly in developing and transition countries. The Convention thus calls upon countries to take appropriate action, supported by international cooperation and agreements, to combat and mitigate the degradation of natural resources, including soils, to rehabilitate partly degraded land, and to reclaim desertified land. The UNCCD should be regarded not only as

an environmental convention, however, since it is very much concerned with development as well, with objectives such as eradicating poverty, economic and social development, and disaster planning, and it goes further than other conventions in urging industrialised nations to provide support in implementing it to developing and transition countries affected by desertification.

In its definitions section, the UNCCD addresses desertification primarily in terms of land degradation and, while it refers to land rather than explicitly mentioning soil, it subsumes soil protection under the combating of desertification. Land is defined in this connection as “the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system” (UNCCD 1999, Article 1(e)).

The Convention focuses sharply on problems that are characteristic of rural parts of developing and transition countries and associated with agricultural land use. This is a product of the historical context in which the Convention came into being and of its emphasis on Africa. By definition, however, its actual scope is broader. Land degradation is defined in the text of the Convention as erosion caused by wind and/or water, deterioration of the physical, chemical and biological or economic properties of soil, and long-term loss of natural vegetation (UNCCD 1999, Article 1(f)). This fully meets the requirements of direct physical protection of the soil.

At the same time, the regional scope of the Convention has already been extended. Supplementing the original regional implementation annexes for Africa, Asia, Latin America and the Caribbean, and the Northern Mediterranean, the Fourth Conference of the Parties to the UNCCD added an annex for Central and Eastern Europe in December 2000. The regional implementation annexes deal with the regional focuses and the specifics of combating desertification.

The UNCCD extends international law to cover soil protection in arid regions and places it on a new footing by introducing various conceptual innovations. These include the attainment of the Convention’s objectives by means of National Action Programmes (Article 10, UNCCD), the generous participatory rights it awards to civil society (Articles 9 and 10, UNCCD), and the undertaking by industrialised countries to provide countries affected by desertification with financial resources and other forms of support to help combat it (Article 6, UNCCD).

The Committee on Science and Technology (CST), a subsidiary body of the Conference, provides information and advice on scientific and technical matters relating to global land degradation.

## **8.2 International soil protection organisations**

Since 1992, the Federal Environment Ministry has taken part in the biennial conferences of the International Soil Conservation Organisation (ISCO), a cooperation platform for scientists, practitioners and public service soil protection experts.

In 1996, the Ministry hosted the 900 delegates to the ninth ISCO conference in Bonn, titled Towards Sustainable Land Use: Furthering Cooperation between People and Institutions. A conference in West Lafayette, USA, followed in 1999 and Buenos Aires in 2000. The 12th ISCO conference took place in May 2002 in Beijing ([www.swcc.org.cn](http://www.swcc.org.cn)).

### **8.3 International Organization for Standards (ISO)**

Considerable work is done on developing methods to assess soil quality in the technical committees ISO/TC 190, Soil Quality and CEN/TC 292, Characterization of Waste. The focus of future development activities is on horizontal standards.

### **8.4 Central/Eastern European and newly independent states**

Since enactment of the Federal Soil Protection Act, Central and Eastern European states (CEE states) and newly independent states (NISs) have taken part in some 20 projects and symposia on the harmonisation and standardisation of physicochemical, chemical and biological investigation procedures and the development and setting of soil quality measurement standards.

### **8.5 NATO Committee on the Challenges of Modern Society**

The Committee on the Challenges of Modern Society (CCMS) was established by the NATO Council in 1969. Its mission is to address existing and future environmental and social problems in support of other NATO programmes.

The Committee has dealt with contaminated sites in various pilot studies since 1981:

- 1981-1984: Contaminated Land  
(Pilot Country: United Kingdom; participants: Canada, Denmark, France, Germany, Netherlands, and USA)
- Since 1986: Evaluation of Demonstrated and Emerging Technologies for the Treatment of Contaminated Land and Groundwater  
(Pilot Country: USA; Co-partner Countries: Netherlands and Germany; Participants: NATO countries, associates and non-associates)

Specific area themes are presented and discussed at each annual meeting. For example:

- 1998: Treatment Walls and Permeable Reactive Barriers
- 1999: Monitored Natural Attenuation
- 2000: Decision Support Tools
- 2001: Performance Verification of In Situ Remediation Technologies

Further information: <http://www.nato.int/ccms/pilot.htm>

### **8.6 Other international activities**

On 13-14 April 2000, the Federal Environment Ministry hosted a symposium, Towards Biological Assessment Strategies and Concepts in Soil Protection, with the aim of drawing up a concept for deriving concentration levels to protect soil organisms in accordance with the Bundesrat resolution on the Federal Soil Protection and Contaminated Sites Ordinance.

Work on standardising and harmonising investigation methods and on deriving concentration levels to protect the soil as a habitat provide the scientific foundations for amendment of the Ordinance.

## Soil awareness

The Federal Soil Protection Act, now in force since 1 March 1999, the ensuing Federal Soil Protection and Contaminated Sites Ordinance and ongoing changes in other policy areas such as regional planning form a regulatory framework for protecting the soil. Yet these are not enough on their own. Everyone can and should contribute towards protecting the soil. For this to happen, soil must, literally, be made more visible.

If we acknowledge its richness, diversity and importance in everyday life, we can take action and responsibility in our use of the soil. We live and work on and with the land, and hence the soil.

Rather than viewing soil as dirt, we must make it second nature to treat soil sparingly and with care. Soil is contaminated almost everywhere by industry, farming, gardens, heating systems and vehicles, not to mention pharmaceuticals. By tolerating unsustainable cultivation methods we lose soil through erosion. The recognised acceptable limit is an annual loss of 10 tonnes per hectare, or about 0.8 cm of topsoil. Every day, Germany uses 129 hectares of new land for residential or commercial building or for transport infrastructure. Surface sealing has a significant impact on the hydrological cycle. Nor can soil perform its role in regulating the climate when the surface is sealed.

Soil is not dirt under our feet, but a neglected natural resource and a biological system about which far too little is known.

Numerous activities by governmental and nongovernmental organisations, of which we will mention only a few by way of example, aim to make the merits of and the services provided by soil part of the canon of general knowledge – in short, to make people ‘soil aware’.

An attractively designed special-issue stamp, *Der Boden lebt* (The Living Soil), in May 2000 helped bring the topic of soil to the attention of the general public. Revenue from the surcharge on the stamp was used to support soil protection-specific projects both nationally and internationally.

Awareness-building begins in childhood. Soil is not only good for playing with, and rather than perceiving it merely as dirt, children should be encouraged to take a positive view of soil from an early age. Ideas and information material are available in various media, including the Internet (for example with information portals such as the German-language [www.bodenwelten.de](http://www.bodenwelten.de)).

Soil is on the school curriculum solely in Baden-Württemberg and North Rhine-Westphalia. It ought to be given equal space in the curriculum alongside the other environmental media, water and air. Soil is everywhere, is part of our natural and cultural heritage and part of the ecosystem, and can be integrated as a topic in various subjects at all school types and levels.

In tertiary education, soil science is usually offered as part of degree courses in agriculture, forestry and geosciences. Pure science disciplines and other courses of study include soil science either not at all or at best as an elective. Graduates who later enter the civil service or engineering are often not sufficiently familiar with the soil.

In May 2001, the Federal Environment Agency published a brochure, *Reiseführer – Zu den Böden Deutschlands: Böden sehen – Böden begreifen* (A Guide to Germany’s Soils: Seeing and Understanding Soil) to raise public awareness of soil. The publication describes 49 sites



(soil trails, archaeological monuments, and museums with a soil-science focus). There was huge demand, and stocks of the brochure quickly ran out despite a reprint.

The Länder, too, actively encourage public interest in soil, for example with exhibitions, teaching trails and web sites (such as [www.uvm.baden-wuerttemberg.de/bofaweb](http://www.uvm.baden-wuerttemberg.de/bofaweb) and [www.bodenbewusstsein.de](http://www.bodenbewusstsein.de))

The Federal Environment Ministry's Scientific Advisory Council on Soil Protection is currently preparing a publication to promote awareness of soil. This will target people (facilitators and communicators) who are directly or indirectly involved with soil. The publication aims to bring together contact points and literature on soil protection activities and to improve information transfer, including ideas and information on teaching about soil.

Local Agenda 21 offers a platform for promoting the cause of soil protection. February 2000 saw the establishment of the Soil Alliance, a network of urban and rural communities which works at local level but has a European dimension. The Soil Alliance gives people in office and others interested in soil issues a forum to advance sustainable use of soil at the local level of action and decisionmaking. The first Annual International Conference of the Soil Alliance was held at Osnabrück on 12-13 November 2001. Following the conference, the European Land and Soil Alliance was formally established at Osnabrück on 31 January 2002.

Broad acceptance of careful and sustainable use of soil as a finite resource among the general public (decisions affecting soil are mostly made by planners, local government, and private and institutional property owners) is a precondition for effective preventive, and remedial, soil protection. Achieving this broad acceptance requires a public relations drive (advertisements, brochures, museums, geoparks and soil trails, teaching packs, web sites, etc.).

## **10     Outlook**

### **10.1    Further development of soil protection law**

With the Federal Soil Protection Act in force for only three years and the Federal Soil Protection and Contaminated Sites Ordinance for only two, it is still too early to pass thorough and in any way final judgement. It is possible, however, to draw preliminary conclusions. The new legislation is Germany's first comprehensive and uniform regulatory framework for protection of the soil. In its enforcement, it has already become clear that stipulations in various areas need to be made more specific. The federal legislation takes on board both prior Länder law and case law, but also incorporates new policy areas, particularly as regards contaminated sites, for example on safeguarding the natural functions of soil and on precautionary measures. It includes new approaches, for example in the field of leachate prediction and the application of organic material. Enforcement experience so far has revealed a considerable need for interpretational guidance in the form of aids, codes of practice and model decrees.

### **10.2    Integration into other policy areas**

The Federal Soil Protection Act alone cannot and is not meant to ensure protection of soil resources. Numerous other areas of law directly or indirectly serve the same end. More closely integrating soil protection into these areas of law thus remains a priority task.

This applies not only to ecological aspects – for example within laws on nature conservation, fertilizer, crop protection products, pollution control, and recycling – but also appropriate economic instruments such as compensation under contractual arrangements, and tax law. Soil protection aspects can and should also be given greater consideration in transport, regional and construction planning.

### **10.3    Advances through soil research**

Soils are complex natural systems with biological, geochemical and physical components whose reactions to anthropogenic influences are only partially known. Action and legislation to protect the soil must take their complexity and diversity into account. Expansion of knowledge through research thus continues to play an indispensable part in evaluating and refining appropriate use of the soil as regards sustainability, the effects of chemical substances and their decomposition and chemical conversion processes, safeguarding the habitat function of soil, minimising the effects of physical influences, determining measurement parameters, indicators, and methods to record and assess them, etc. Intensive use is made of basic (Federal Ministry of Education and Research) and thematic research resources (Federal Ministry for the Environment and the Federal Ministry of Consumer Protection, Food and Agriculture).

### **10.4    Contaminated sites and site management**

Undisputedly one of the key parts of the Federal Soil Protection Act is its set of provisions on rehabilitation investigations and rehabilitation planning for contaminated sites. The trigger and action values laid down in the Federal Soil Protection and Contaminated Sites Ordinance create a framework for identifying and assessing the need for remediating such

sites. Exploration and remediation of contaminated sites in Germany is not yet complete, and according to the Federal Government remains a priority task. In future, however, site remediation will gradually give way to site management with the primary focus (after risk containment) on preparing sites for reuse.

As regards funding the remediation of contaminated sites under the administrative agreement with the eastern German Länder, the Federal Government will press on with the current negotiations in order to reach final settlement on the few remaining sites.

## **10.5 Improving soil protection at EU level**

The discussion process in course of the various European Soil Forums has proved extremely helpful, and consequently should not only be continued, but actively shaped and guided. The same applies for cooperation on soil protection with EU accession candidates.

The EU Commission is currently conducting, as part of a Thematic Strategy, an in-depth examination of the various Community policies to identify policy impacts and interdependencies that have a bearing on soil protection. Once the Commission has published its formal communication to the Council and the European Parliament, the German Federal Government and German Länder will formulate a negotiating position. This will both serve as a constructive contribution to the coming discussions at EU level and help lay the foundations for greater consideration of soil protection issues.

## **10.6 Internationalising soil protection**

The Federal Government remains committed to increasing the consideration of soil protection issues in the international arena. This applies equally to bilateral and multilateral development projects, cooperation with Central and Eastern European states, carrying forward the Deserts Convention, and the preparations for and activities following the World Summit in Johannesburg.

## **10.7 Creating soil awareness**

Under Article 4(1) of the Federal Soil Protection Act, anyone whose actions affect the soil must act in such a way as to prevent soil degradation. While this general rule is now largely accepted throughout the legislature and the executive, there is still a long way to go before strict compliance is attained in all relevant areas of life. Looking after the soil must become a matter of course. Achieving this means creating and heightening soil awareness: awareness of the importance and functions of soil and the need to make certain concessions to protect it. Germany has a soil museum and numerous soil trails, and an encouraging quantity of material suitable for use in schools gets across the 'living soil' message. *Der Boden lebt*, The Living Soil, was also the subject of a special-issue stamp which helped bring attention to the high value and conservation merit of soil as an environmental medium. As part of its public relations activities, the Federal Government will continue in its endeavours to convince the public that sustainable use of the soil is critical in protecting the natural resources on which life depends.

## **10.8 From remediation to preventive soil protection**

Besides cleaning up contaminated sites, increasing importance will be attached in future to recycling concepts in land use and to preventive soil protection. Provisions designed to permanently avert the creation of new contaminated sites are an equally important focus of soil protection law as dealing with existing contamination. The Federal Environment Ministry has summarised the future tasks in this field in a conceptual strategy on preventive soil protection (published in *Umwelt*, 9/2001). Furthermore, the knock-on effects of soil protection legislation on other areas of the law, including the incorporation of precautionary values in relevant measures and stipulations, lead to improved protection of the soil in other related bodies of law.

## **10.9 Limiting pollution of agricultural land**

In view of the special importance of agricultural land in the production of food that is low in contaminants, precautions must be taken to prevent pollutant accumulation in soil as a result of fertilizer use. Consequently, such pollution must be measured independently of the type of fertilizer used and according to uniform standards. Long-term accumulation of pollutants in soil must be prevented on the basis of the existing precautionary values laid down in the Federal Soil Protection and Contaminated Sites Ordinance. Putting these principles into action requires realistic transitional arrangements to reduce the pollutant levels in fertilizers that are kept in use.