Soil quality

The soil forms the weathering layer of the Earth's solid crust. Its characteristics and development depend on the prevailing geological, topographic, climatic, hydrological and biological conditions. The term "soil quality" is generally taken as referring to a soil's suitability as a location for plants in the sense of its productivity. A frequently used synonym is the term "soil fertility", which describes the soil's ability to supply plants with nutrients, water, oxygen and warmth.

Apart from providing the basis for food production, soil conditions create the essential prerequisites for all terrestrial production of phytomass and thus form the foundation of virtually every food chain.

In addition to performing this vital role in safeguarding the existence of higher life forms, soils fulfil an important function within an ecosystem as

- filters and sinks for potential pollutants
- a habitat for soil flora and fauna
- the site of conversion and breakdown processes forming part of natural cycling systems.

The major types of impact on the soil can be classified as follows according to their basic nature:

1. Chemical changes result from

- application of fertilisers
- use of biocides and
- pollution caused by various immissions and depositions of anthropogenic origin (direct introduction of pollutants by wastes and waste materials, either solid (sanitary landfills, tips) or liquid (waste water, hydraulic fill); indirect introduction of pollutants following aerial transmission, through deposition of liquid or solid aerosols and introduction via precipitation).

2. Physical changes result from

- removal of soil (removal of individual layers, excavation)
- changes in the natural vegetation cover (land clearance, use of land for forestry)
- tillage (use of land for agriculture, terracing etc.).

3. Biological changes result from

- use of biocides and
- introduction of potential pollutants.

Changes in the water balance generally have direct effects on the chemical, physical and biological conditions in the soil.

The principal soil parameters are as follows:

- With regard to physical condition:
Structure, aggregate stability, pore volume and distribution, granulometric composition, density of mineral matter, density of organic matter and soil temperature

- With regard to chemical condition:
Content and chemical composition of mineral and organic matter, acidity, ion exchange capacity, redox properties

- With regard to biological condition:
Nature, composition and size of the edaphon

Analytical determination of soil condition, particularly of chemical properties and the reaction mechanisms and processes controlled by them, may present considerable problems in some respects.

Apart from determining the chemical composition of soils as mentioned above, the following key parameters are generally used for establishing soil quality:

- granulometric composition
- organic-matter content
- pH value
- cation exchange capacity
- base saturation
- field capacity/available field capacity

It should be borne in mind that soils yielding identical individual values are not necessarily of identical quality. Soil classifications (which vary depending on purpose and viewpoint) must be drawn upon in determining standards which take account of the diversity of soils and their optimum condition in each case.

Standards relate to soil quality in terms of suitability for agricultural use (soil evaluation), to erosion risks and to pollutant deposition. The Register of Substances contains more detailed information about substance-specific soil quality standards.

Agricultural and forestry land

Agricultural land provides the raw materials necessary to ensure a food supply. The amount of land needed per capita to meet staple-food requirements varies depending on geoecological conditions (particularly soil quality, available water supply and climate), eating habits and the level of development attained in agricultural engineering. The figure arrived at on the basis of a region's population and the above conditions can be taken as a standard for the amount of agricultural land required. In view of the influencing factors referred to above, standards of this type can be determined only on a region-specific basis.

Disregarding the ecological functions performed by forests, the minimum amount of forestry land required is determined by the population's requirements in terms of wood and other usable

forest components (leisure, medicaments, plants/fruits etc.). It depends on geoecological conditions and local habits (e.g. fuel needs).

The availability of agricultural and forestry land is influenced in particular by

- changes in the purpose for which land is used (transforming forests into agricultural land, transforming agricultural and forestry land into areas for settlement, transport routes, industry, mining operations etc.);

- the damage done to the soil by pollutants, erosion, removal etc. as the direct or indirect consequence of other economic activities or minimally site-appropriate cultivation practised with a view to preserving the soil's usability in the long term.

In general, such standards for the minimum amount of agricultural land required take the form of empirical values applying to specific countries or regions. Depending on the conditions outlined above, the figure given may be many square kilometres (extensive pasture farming), roughly one square kilometre (shifting cultivation), one hectare (e.g. rice-growing) or less (horticulture). No corresponding figures are known to exist for forestry land.

4.8 Biotope conditions (special biotope functions)

This section covers biotope-related aspects not considered in connection with the environmental quality parameters previously discussed. In terms of composition and density, vegetation and fauna constitute a community (biocoenosis) which has developed over a lengthy period through the interaction of the relevant ecological factors and which occupies a more or less precisely defined habitat (biotope). An ecosystem consists of an indefinite number of biotopes exhibiting a specific form of interdependence.

The conditions to be met by an "intact" biotope are derived from the communities' requirements in terms of the environment necessary for the preservation of species. The major determining factors are

- biotope-specific minimum area
- interlinking of areas
- diversity of structure and species (to offset disturbing influences)
- absence of disturbances.

Scientific research has yielded findings on effect chains in ecosystems, the extent of changes caused by external influences and the biotope requirements of individual species (above all particular index species such as large fauna, birds and protected species) which make it possible to define area-specific "environmental standards". Every species (flora or fauna) forms part of a biotope, where it plays a (generally) indispensable role. If one element of a biotope is removed, both the composition and the functioning of the biotope will be changed or disrupted. Although there are no standards (in the strict sense) for biotope conditions that ensure preservation of fauna and flora, such standards can be formulated for specific regions on the basis of the characteristics of the region's typical biotopes. Certain attempts are being made to find a

meaningful substitute by considering natural substance cycling systems and the energy cycle. Apart from the national protected status of specific areas, one pointer for determining the extent to which areas merit protection could be provided by information on the (potential) occurrence of protected species (e.g. species threatened with extinction). Particular attention must be drawn to the Washington Convention on International Trade in Endangered Species (see section on the international environment legislation) and Germany's Federal Ordinance on the Conservation of Species. However, the "red lists" are based only on the criteria of endangerment and rarity. Other criteria should also be taken into account, e.g. benefits and importance for the natural household or the need to preserve the diversity and characteristic features of the natural environment and the landscape. Measures to protect biotopes must be concretised in line with specific regional needs following analysis of relevant conventions to obtain information on particular species.