Contamination

CONTAMINATION is the occurrence of a substance in soil above a certain level. Contamination can be diffuse or local and is due to many anthropogenic activities, such as industrial production, traffic, farming practices and waste disposal.

Pesticides, used to protect crops from insects and diseases, can in certain circumstances lead to diffuse pollution of soils (AJ).

Soil acts as a sink for almost all substances released into the environment by human activities. Therefore, many pollutants accumulate in the soil due to the specific filtering and buffering properties of the soil. On the other hand, many substances occur naturally in soil (e.g. heavy metals). If the concentration of these substances is above a defined background value or so high that it potentially causes a risk to human health, plants, animals, ecosystems or other media (e.g. water), the soil is regarded as "contaminated". Many parts of Europe are contaminated by a range of contaminants. They originate from either local or diffuse sources of human activity.

Contamination from localised sources

Soil contamination from localised sources is often related to industrial plants that are no longer in operation, accidents or improper waste disposals. At industrial plants that are still operating, soil contamination may have its origin in the past but current activities still have significant impacts.

Contaminated sites are the legacy of a long period of industrialisation involving uncontrolled production and handling of hazardous substances and unregulated dumping of wastes. The expansion of industry and subsequent increase in the amount of industrial wastes have led to considerable environmental problems. Mining activities and former military sites are also giving rise to severe contamination problems.

Contaminated sites considerably endanger human health and the environment. Pollution of drinking water, uptake of pollutants in plants, exposure to contaminated soil due to direct contact, inhalation and ingestion are major threats. Soil and groundwater contamination can be caused by losses during production, industrial accidents and leaching of hazardous substances at waste disposal sites. Major pollutants include organic contaminants such as chlorinated hydrocarbons, mineral oil and heavy metals.

Assuming that areas with a high probability for soil contamination from local sources are concentrated in densely populated and industrialised regions, the largest and probably most heavily affected areas are concentrated around the industries from the Nord-Pas de Calais in France to the Rhine-Ruhr region in Germany, across Belgium and the Netherlands and the large cities of the UK (see population density map on Page 123).

Other areas where the probability of local soil contamination is high include the Saar region in Germany; northern Italy, north of the river Po area, from Milan to Padua; the so-called Black Triangle region located at the corner of Poland, the Czech Republic and the Slovak Republic. However, contaminated areas exist around most major cities and some individual contaminated sites also exist in sparsely populated areas.

The management of contaminated sites is designed to remediate any adverse effects where impairment of the environment has been proved and to minimise potential threats. Provision of public and private money for remediation, as well as restrictions on land use and the use of groundwater and surface water, are particularly important responses to deal with the existing contaminated sites. Although the "polluter-pays" principle is generally applied, a huge sum of public money must be provided to fund necessary remediation activities. A problem can arise when the polluter is not financially liquid or the polluter can not be made liable! Even though a considerable amount of money has been spent on remediation activities already, the share compared to the total estimated remediation costs is relatively low (only around 8%).

Contamination from diffuse sources

Intensive agriculture, forestry, mining, transport, industrialization and urbanization in densely populated areas in Europe have led to inter-related problems of contamination and other forms of land degradation. Transport of acidifying and eutrophying components as well as potentially harmful elements by wind has led to soil degradation even in distant areas. Additionally, certain agricultural practices cause diffuse soil contamination by direct application of pesticides, sewage sludge, compost, fertilisers and manure.

Continued contamination can lead to an accumulation of hazardous substances in top soils. Soil functions most affected by contamination are buffering, filtering and transforming capacities. When the buffering capacity of soil with respect to a certain substance is exceeded, the substance is released to the environment, causing impairment of groundwater and/or surface water. Currently, the most important problems from diffuse sources are acidification, the effects of a surplus of nutrients and contamination by heavy metals.

Emissions of acidifying sulphur and nitrogen compounds from industry and transport have led to soil acidification and pose threats to forest health and the quality of surface and/or groundwater. Aluminium, cadmium and many other metals are more mobile in acid soils causing risk of damage to plant roots and contamination of drinking water. Sulphur emissions and deposition have declined substantially. Excesses of acidifying components in terrestrial ecosystems are at present dominated by nitrogen deposition, although the situation is not homogenous throughout Europe. Nitrogen and phosphorus are essential elements for plant growth and are added to soil by fertilization. However, if fertilizers are applied beyond what plants can use and soils

The application of new legislation at national and EU level (e.g. the Landfill Directive, Water Framework Directive, Environmental Liability Directive, Integrated Pollution and Prevention Control Directive) should result in better operational and technical requirements on waste and landfills (AJ).

can retain, the excess may be leached from the soil, eroded or washed off into ground waters and/or surface waters. Besides over-application of fertilizers, accumulation of nitrogen can be caused by wet and dry nitrogen deposition. Elevated nitrogen content in forest soils can negatively affect the vitality of European forests. According to estimations based on critical load data the excess deposition of nutrient nitrogen will be much lower by 2010 in comparison to 1990, but still in some areas of central and western Europe only less than 10% of the ecosystems will be protected against negative effects of eutrophication.

Deposition of heavy metals and other potentially harmful elements cause diffuse soil contamination throughout Europe. In forest soils, contamination is generally linked to atmospheric deposition. In agricultural soils, heavy metals and other contaminants enter ecosystems as a result of the application of fertilizers and animal manure, compost and pesticides. The application of contaminated sewage sludge has the potential to create a threat to soil ecosystems due to input of heavy metals, organic compounds and pathogens. In Eastern and Northern Europe, the fallout from Chernobyl can be still identified as a diffuse radioactive contamination of surface soil, but at a lower value than in the late 1980's. Much attention has been paid so far to diffuse contamination by cadmium, lead and mercury. Other potentially harmful elements include arsenic, chromium, copper, nickel, zinc and several persistent organic pollutants (POPs).

Reductions in heavy metal deposition can be expected throughout Europe as the result of the implementation of lead-free petrol and the application of industrial techniques of emission reduction. Concerning direct input of contaminants to agricultural soils, common Good Agricultural Practices and water protection legislation have to consider avoidance of soil contamination and related EU legislation.

The risk of soil contamination from mining activities is associated with the storage or disposal of tailings, acid mine drainage and the use of certain chemical reagents in the processing of metal ores. This striking photograph shows an old copper mine in the UK more than 100 years after the mine was abandoned. Notice the lack of vegetation on the soil heaps. The pH of some of the old tailing ponds can be as low as 2.5, strong sulphuric acid! (AJ).