# Soil degradation (1)

## TYPES OF SOIL DEGRADATION

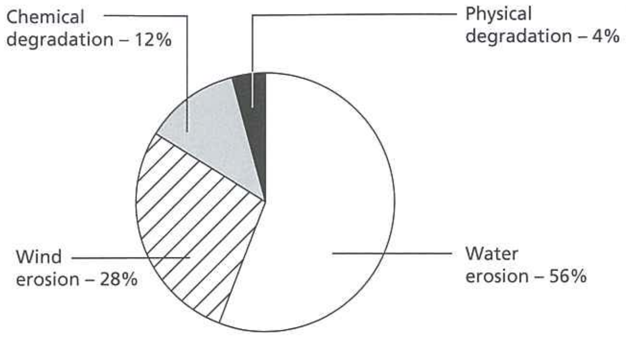
**Soil degradation** is the decline in quantity and quality of soil. It includes:

- erosion by wind and water
- biological degradation (the loss of humus and plant/animal life)
- physical degradation (loss of structure, changes in permeability)
- chemical degradation (acidification, declining fertility, changes in pH, salinization and chemical toxicity).

There are many types of water erosion, including surface, gully, rill and tunnel erosion.

Water and wind erosion account for more than 80% of the 20 million km$^2$ of degraded land worldwide.

Acidification is the change in the chemical composition of the soil, which may trigger the circulation of toxic metals.




Salt-affected soils are typically found in marine-derived sediments, coastal locations and hot arid areas, where capillary action brings salts to the upper part of the soil. Soil salinity has been a major problem in Australia following the removal of vegetation in dryland farming.

## THE UNIVERSAL SOIL LOSS EQUATION (USLE)

The universal soil loss equation **A = RKLSCP** is an attempt to predict the amount of erosion that will take place in an area on the basis of certain factors which increase susceptibility to erosion.

| Factor | Description |
|---|---|
| *Ecological conditions* | |
| Erosivity of soil **R** | Rainfall totals, intensity and seasonal distribution. Maximum erosivity occurs when the rainfall occurs as high-intensity storms. If such rain is received when the land has just been ploughed or full crop cover is not yet established, erosion will be greater than when falling on a full canopy. Minimal erosion occurs when rains are gentle and fall onto frozen soil or land with natural vegetation or a full crop cover. |
| Erodibility **K** | The susceptibility of a soil to erosion. Depends on infiltration capacity and the structural stability of soil. Soils with high infiltration capacity and high structural stability, which allow the soil to resist the impact of rain splash, have lowest erodibility values. |
| Length-slope factor **LS** | Slope length and steepness influence the movement and speed of water down the slope, and thus its ability to transport particles. The steeper the slope, the greater the erosivity; the longer the slope, the more water is received on the surface. |
| *Land-use types* | |
| Crop management **C** | Most control can be exerted over the cover and management of the soil, and this factor relates to the type of crop and cultivation practices. Established grass and forest provide the best protection against erosion; of agricultural crops, those with the greatest foliage and thus greatest ground cover are optimal. Fallow land or crops that expose the soil for long periods after planting or harvesting offer little protection. |
| Soil conservation **P** | Soil conservation measures, such as contour ploughing, bunding, use of strips and terraces, can reduce erosion and slow runoff water. |

*Factors relating to the universal soil loss equation (USLE)*

## CAUSES OF DEGRADATION

Causes of soil or land degradation include:

- the reduction of the natural vegetative cover, which renders the topsoil more susceptible to erosion
- unsustainable land-use practices such as excessive irrigation, the inappropriate use of fertilizers and pesticides and overgrazing by livestock
- groundwater overabstraction, which may lead to dry soils, resulting in physical degradation
- atmospheric deposition of heavy metals and persistent organic pollutants, which make soils less suitable to sustain their original land cover and land use.

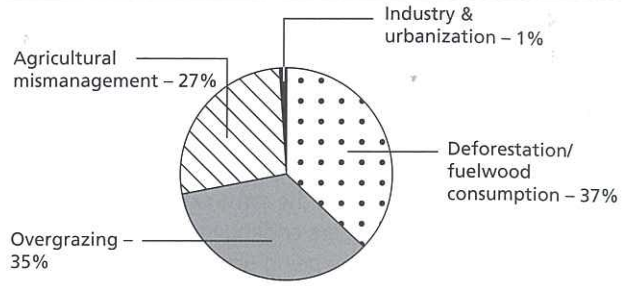
Climate change will probably intensify the problem. It is likely to affect hydrology and hence land use.



# Soil degradation (2)

## CAUSES OF DEGREDATION (CONTINUED)

Overgrazing and agricultural mismanagement affect more than 12 million km$^2$ worldwide. The situation is most severe in Africa and Asia, where 20% of the world's pasture and rangelands have been damaged. Huge areas of forest are cleared for logging, fuelwood, farming or other human uses.




## THE EFFECTS OF LOSS OF COVER

The removal of vegetation and topsoil has resulted in:

- increased surface runoff and stream discharge
- reduction of water infiltration and groundwater recharge
- development of erosional gullies and sand dunes
- change in the surface microclimate that enhances aridity
- drying up of wells and springs
- reduction of seed germination of native plants.

## MANAGING SOIL DEGRADATION

Abatement strategies, such as afforestation, for combating accelerated soil erosion are lacking in many areas. To reduce the risk of soil erosion, farmers are encouraged towards more extensive management practices such as organic farming, afforestation, pasture extension and benign crop production. Nevertheless, there is a need for policymakers and the public to intensify efforts to combat the pressures and risks to the soil resource.

Methods to reduce or prevent erosion can be mechanical, for example physical barriers such as embankments and windbreaks, or they may focus on vegetation cover and soil husbandry. Overland flow can be reduced by increasing infiltration.

### Mechanical methods

Mechanical methods include bunding, terracing and contour ploughing, and shelter belts such as trees or hedgerows. The key is to prevent or slow the movement of rainwater downslope. Contour ploughing takes advantage of the ridges formed at right angles to the slope to act to prevent or slow the downward accretion of soil and water. On steep slopes and in areas with heavy rainfall, such as the monsoon in South-East Asia, contour ploughing is insufficient and terracing is undertaken.

The slope is broken up into a series of flat steps, with bunds (raised levées) at the edge. The use of terracing allows areas to be cultivated that would not otherwise be suitable. In areas where wind erosion is a problem, shelter belts of trees or hedgerows are used. The trees act as a barrier to the wind and disturb its flow. Wind speeds are reduced, which therefore reduce the wind's ability to disturb the topsoil and erode particles.

### Cropping techniques

Preventing erosion by different cropping techniques largely focuses on:

- maintaining a crop cover for as long as possible
- keeping in place the stubble and root structure of the crop after harvesting
- planting a grass crop – grass roots bind the soil, minimizing the action of the wind and rain on a bare soil surface.

Increased organic content allows the soil to hold more water, thus preventing aerial erosion and stabilizing the soil structure. In addition, care is taken over the use of heavy machinery on wet soils and ploughing on soil sensitive to erosion, to prevent damage to the soil structure.

### Managing salt- and chemical-affected soils

There are three main approaches in the management of salt-affected soils:

- flushing the soil and leaching the salt away
- application of chemicals, such as gypsum (calcium sulphate) to replace the sodium ions on the clay and colloids with calcium ones
- a reduction in evaporation losses to reduce the upward movement of water in the soil.

Equally specialist methods are needed to decontaminate land made toxic by chemical degradation.

## LAND DEGRADATION IN BARBADOS

The most significant area of land degradation in Barbados is within the Scotland District. Changing land-use practices and the application of inappropriate agricultural techniques (growing sugar cane on very steep slopes, for example) have resulted in significant and visible loss of soils.

### Controlling land degradation

One of the most effective ways in which land degradation can be controlled is through increasing the vegetative cover within the affected area. Farmers in the region are taught methods which include keeping the soil covered, incorporating organic matter to assist with percolation and reducing the use of fertilizers.