# Salinisation and sodification

## What are salinisation and sodification?

Salinisation is the accumulation of water-soluble salts in the soil. These salts include potassium ($K^+$), magnesium ($Mg^{2+}$), calcium ($Ca^{2+}$), chloride ($Cl^-$), sulphate ($SO_4^{2-}$), carbonate ($CO_3^{2-}$), bicarbonate ($HCO_3^-$) and sodium ($Na^+$). The accumulation of sodium is also called sodification. Salts dissolve and move around with water. When the water evaporates, the salts are left behind.

*Destruction of soil structure as a result of excess sodium (Source: Soil Atlas of Europe)*

Primary salinisation involves salt accumulation through natural processes due to a high salt content of the parent material or in groundwater. Secondary salinisation is caused by human interventions such as inappropriate irrigation practices, for example with salt-rich irrigation water and/or insufficient drainage.

## Why is it important to fight salinisation and sodification?

The accumulation of salts (particularly sodium salts) is one of the main physiological threats to ecosystems. Salt disturbs plant development by limiting its nutrient uptake and reducing the quality of the water available to the plant. It affects the metabolism of soil organisms, leading to severely reduced soil fertility. High levels of salinity in soils provoke the withering of plants as a result both of the increase in osmotic pressure and the toxic effects of salts.

An excess of sodium results in the destruction of the soil structure, which, due to the lack of oxygen, becomes incapable of sustaining either plant growth or animal life.

Salinisation increases the impermeability of deep soil layers, making it impossible to use the land for cultivation.

## Causes

Factors leading to excessive accumulation of salts in soil may be natural or anthropogenic.

***Environmental (natural)*** factors that result in salinisation or sodification:

- geological events, which can increase the concentration of salts in groundwater and consequently in soils;
- natural factors, which can channel salt-rich groundwater to the surface, near the surface or to horizons above the groundwater table;

- groundwater seepage into areas lying below sea level, that is, micro-depressions with little or no drainage;
- waters flooding from areas with geological substrates that release large amounts of salts;
- wind action, which in coastal areas can blow moderate amounts of salts inland.

Natural factors influencing the salinity of soils are climate, soil parent material, land cover, vegetation type and topography.

***Human-induced factors*** that may lead to salinisation or sodification:

- irrigation with waters rich in salts;
- rising water table due to human activities (filtration from unlined canals and reservoirs, uneven distribution of irrigation water, poor irrigation practices, improper drainage);
- use of fertilisers and other inputs, especially where land under intensive agriculture has low permeability and limited possibilities of leaching;
- use of wastewaters rich in salts for irrigation;
- salt-rich wastewater disposal on soils;
- contamination of soils with salt-rich waters and industrial by-products.

The most influential human-induced factors are land use, farming systems, land management and land degradation. Inappropriate irrigation practices (such as the use of salt-rich irrigation water) and insufficient drainage both cause salinisation.

Salinisation and sodification are often associated with irrigated areas where low rainfall, high evapotranspiration rates or soil textural characteristics impede the washing of salts out of the soil, which subsequently build up in the surface layers. Irrigation with water that has a high salt content dramatically worsens the problem.

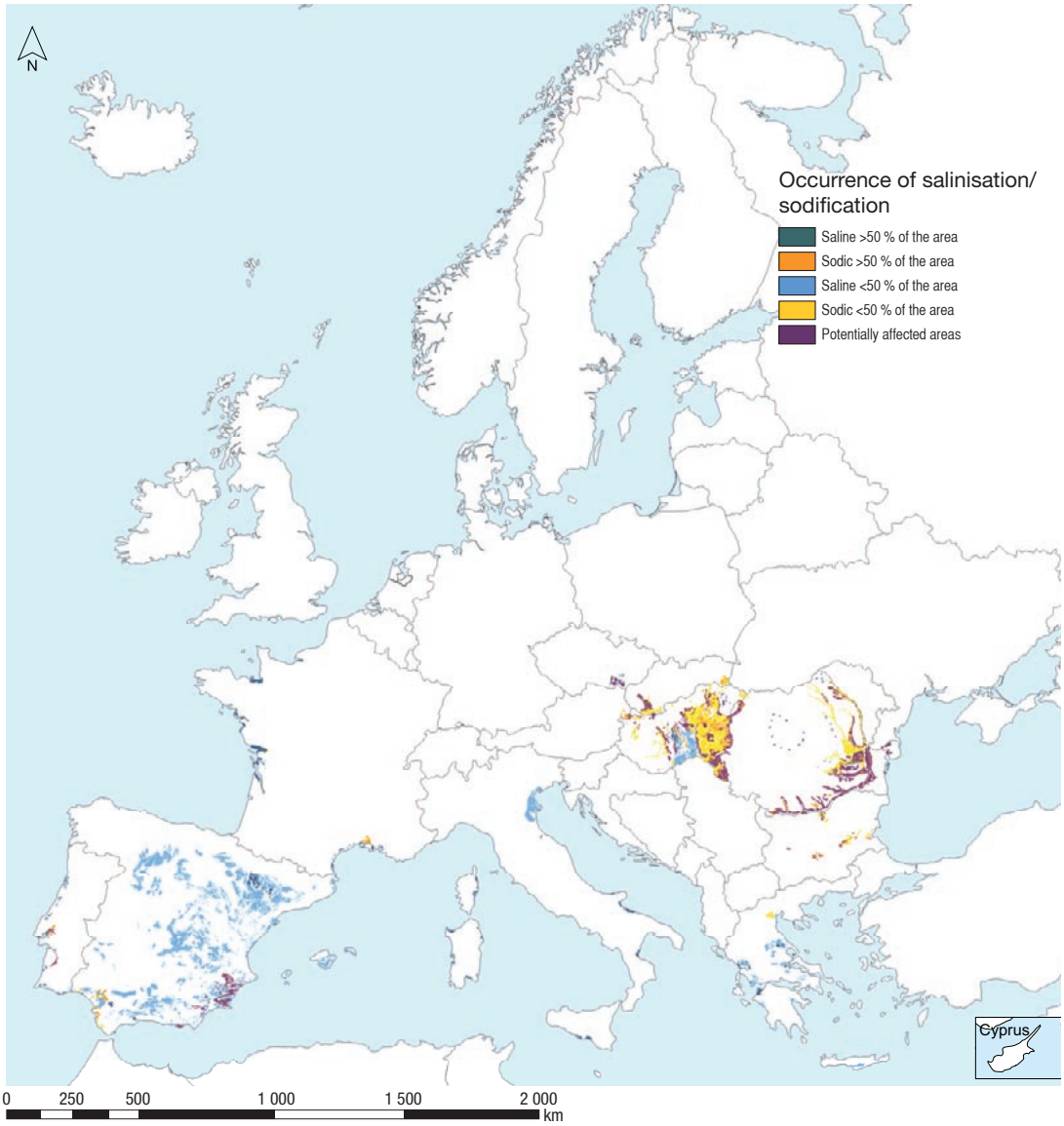
In coastal areas, salinisation may be associated with the over-exploitation of groundwater caused by the demands of growing urbanisation, industry and agriculture. Over-extraction of groundwater can lower the normal water table and lead to the intrusion of seawater.

## Location and magnitude

Salinity is one of the most widespread soil degradation processes on Earth. In Europe, salt-affected soil occurs in Hungary, Romania, Greece, Italy and on the Iberian Peninsula. In Nordic countries, the de-icing of roads with salts can lead to localised salinisation.

Soil salinisation affects an estimated 1 to 3 million hectares in the EU. It is regarded as a major cause of desertification and is therefore a serious form of soil degradation. With the increases in temperature and decreases in precipitation characteristic of climate in recent years, the problem of salinisation in Europe is getting worse.

*Saline deposition in a soil profile (Hungary) (Mollic Solonetz - World Reference Base for Soil Resources 2006) (Source: Gergely Tóth)*




*Map showing saline and sodic soils in the 27 Member States of the European Union*

## Links with other soil degradation processes and/or environmental issues

Salinisation greatly reduces soil quality and vegetation cover. Due to the destruction of the soil structure, saline and sodic soils are more easily eroded by water and wind. When land degradation occurs in arid, semi-arid and subhumid areas it is known as desertification. Salinisation induces desertification effects such as loss of soil fertility, soil structure destruction and compaction, and soil crusting.

## Further reading

http://soco.jrc.ec.europa.eu
http://eusoils.jrc.ec.europa.eu/projects/soil_atlas/

This fact sheet is based on the findings of the 'Sustainable agriculture and soil conservation' (SoCo) project. It is part of a package of ten sheets organised around the three main topics of the project. The sheets cover the following topics:

- Introduction:
  - Fact sheet no. 1: Linking soil degradation processes, soil-friendly farming practices and soil-relevant policy measures;

- Soil degradation processes:
  - Fact sheet no. 2: Water erosion and compaction;
  - Fact sheet no. 3: Organic matter decline;
  - Fact sheet no. 4: Salinisation and sodification;

- Soil-friendly farming systems and practices:
  - Fact sheet no. 5: Conservation agriculture;
  - Fact sheet no. 6: Soil-friendly tillage practices;
  - Fact sheet no. 7: Soil-friendly farm infrastructure elements;

- Soil-relevant policies:
  - Fact sheet no. 8: Requirement to keep land in good agricultural and environmental condition (GAEC);
  - Fact sheet no. 9: Agri-environment measures;
  - Fact sheet no. 10: Advisory services.

All SoCo fact sheets and project reports can be downloaded at: http://soco.jrc.ec.europa.eu.

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