

Water erosion and compaction

What is erosion?

Erosion is the loss of soil. When raindrops reach the soil, they detach soil particles. The degree to which this happens depends on the size and speed of the falling raindrops. The detached soil particles are subsequently transported by overland water flow. Some particles fill up soil voids, sealing the soil surface. Erosion occurs when the precipitation rate exceeds the infiltration rate of the soil.



(Source: Stephan Hubertus Gay)



(Source: Agenzia per i Servizi nel Settore Agroalimentare delle Marche, Italy)

What is compaction?

When pressure is applied to the soil surface, compaction takes place. This alters soil properties such as porosity and permeability. Pores become disconnected and gas and water movement through soil is impeded, leading to reduced availability of water and oxygen. Root growth becomes restricted.

Why is it important to fight against erosion and compaction?

Soil is removed by erosion much more rapidly than soil-forming processes can replace it. The loss of topsoil leads to reduced fertility, resulting in lower yields. The transported soil also contributes to the contamination and silting up of waterways.

Soil compaction reduces the soil's capacity to retain water and to supply oxygen to plant roots. When a soil is less capable of holding water yields decrease, water run-off increases and soils will be more vulnerable to soil erosion.

What causes erosion or compaction?

Water erosion is a natural process; the major drivers are intense rainfall, topography, low soil organic matter content, percentage and type of vegetation cover. It is however intensified and accelerated by human activities, such as inappropriate cultivation techniques and cropping practices, changes in hydrological conditions, deforestation and land marginalisation or abandonment.

Inappropriate land management is the main cause of soil compaction. Too many livestock for a certain field size, the inappropriate use of heavy machinery in agriculture and tillage of a field when it is too wet are examples of this. Wet soils are not strong enough to offer resistance to the weight and this leads to compaction.

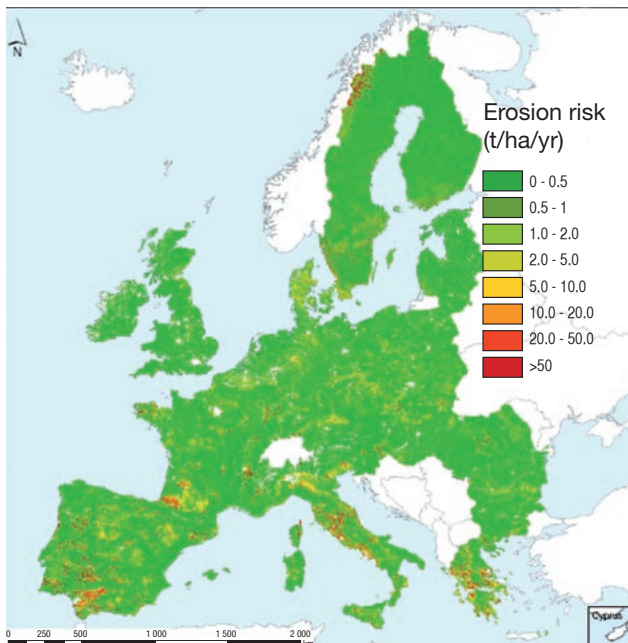
What damage does erosion cause?

On-site damage due to water erosion	Off-site damage due to water erosion
<ul style="list-style-type: none"> • Loss of organic matter • Soil structure degradation • Soil surface compaction • Reduced water infiltration • Reduced supply of water to the water table • Soil loss at the surface • Nutrient removal • Increase of the coarse fraction of soils • Rill and gully generation • Plant uprooting • Reduction of soil productivity 	<ul style="list-style-type: none"> • Water pollution • Water eutrophication • Floods • Burial of infrastructure • Obstruction of drainage networks • Changes in shape of watercourses • Silting up of waterways and ports



Occurrence of sediment in the Mediterranean Sea due to transport of soil particles from eroded inland fields (Italy) (Source: Agenzia per i Servizi nel Settore Agroalimentare delle Marche, Italy)

Location and magnitude



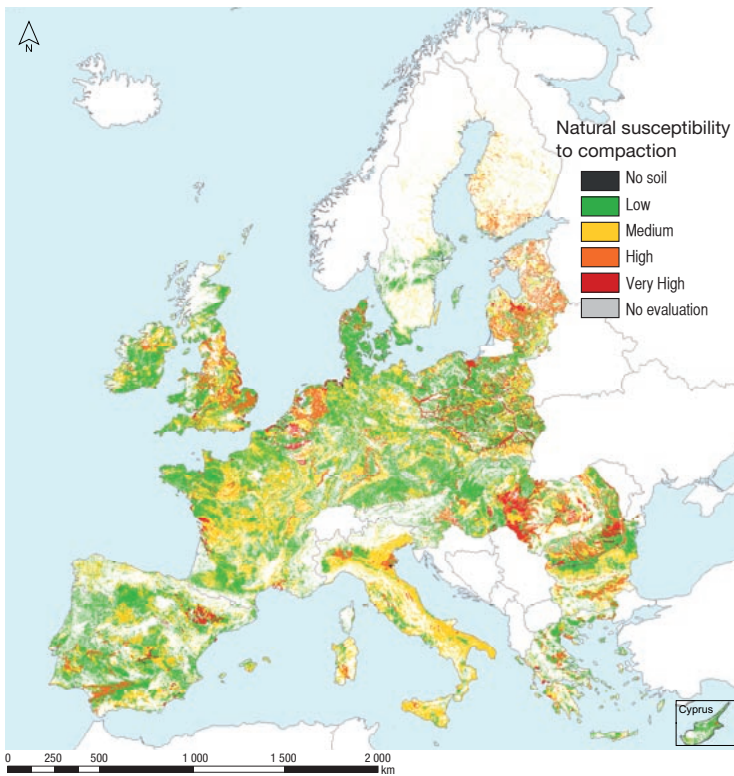
Map showing the risk of water erosion in the 27 Member States of the European Union



Example of rill erosion and re-deposition of sediment at the base of the slope (Source: Soil Atlas of Europe)

An estimated 115 million hectares – one eighth of Europe’s total land area – are subject to water erosion, and 42 million hectares are affected by wind erosion. The Mediterranean is particularly prone to erosion when heavy rain occurs after long dry periods.

It is estimated that a third of European subsoils are very vulnerable to compaction and a fifth moderately so. Susceptibility to compaction depends on soil texture; it ranges from sand (least susceptible) – loamy sand – sandy loam – loam –clayey loam – loamy clay – to clay soils (most susceptible to natural compaction).



Map showing the natural susceptibility of soils to compaction in the 27 Member States of the European Union



Harvester for sugar beet (Source: Soil Atlas of Europe)



Compacted soil (Source: Soil Atlas of Europe)

Links with other soil degradation processes and/or environmental issues

The soil's ability to resist erosive meteorological conditions (e.g. wind, rain, running water) depends mainly on soil texture and organic matter content, which influence the water-holding capacity and the ability of the soil to produce aggregates or crusts. When erosion occurs, the loss of topsoil causes a reduction in the soil's fertility and contaminates the aquatic ecosystem. Loss of soil fertility and the breakdown of structure ultimately lead to desertification.

Soil compaction can induce or accelerate other soil degradation processes, such as erosion or landslides. Compaction reduces the infiltration rate, which increases run-off in sloping areas. Also, the presence of a layer with low permeability makes the upper part of the soil more prone to saturation with water and thus heavier. This upper part is at risk of sliding and causing landslides. On plains, compaction can cause waterlogging, resulting in the destruction of aggregates, and causing crust formation. Soil structure is improved by soil organic matter, reducing the soil's susceptibility to compaction, erosion and landslides.

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>.

