



ENGAGING CITIZENS IN SOIL SCIENCE:  
THE ROAD TO HEALTHIER SOILS

## Protecting and improving soil fertility in Europe

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Soil is an essential, non-renewable and irreplaceable resource. Fertile soils are the foundation of our economy, society and environment. Soil supports our well-being through food production and increases the resistance of plant-growing ecosystems to extreme climate changes, droughts, high temperatures and floods. Fertile soils store carbon dioxide, have a greater capacity to absorb, store and filter water, and enable the production of nutrient-rich food and plant biomass.

Scientific evidence shows that around 60–70% of the soil in the EU is currently in poor condition. All Member States are facing the problem of increasing soil degradation in Europe. The causes and effects of this problem transcend national borders, reducing the capacity of soil to perform essential production functions across the EU and in neighboring countries. This poses risks to public health, animal welfare, the environment, the climate and the economy. The significant loss of agricultural soil fertility is a serious threat to food security, biomass production and water quality through the increasing impacts of floods, droughts, carbon emissions, and the loss of soil biodiversity. Soils are of geostrategic importance when it comes to food production. Fertile soils are crucial to producing enough food for the world's growing population, which is projected to reach 9–10 billion people by 2050. Globally, 95% of food comes directly or indirectly from field crops. Soil degradation and loss of natural resources and soil used for agriculture reduces the availability of agricultural produce.

According to European Commission standards, organic matter content below 3.5% leads to steppe formation, while a drop below 1.7% precedes desertification of such areas, which necessitates soil recultivation. The share of neutral and alkaline soils that do not require liming does not exceed 18%. According to data in Poland, as much as 60% of land is acidic or very acidic. It is estimated that approximately 33% of the soil in the world is degraded.

In recent years, more than 4.2% of agricultural land has been lost in EU countries through conversion for construction purposes. It is estimated that between 61% and 73% of agricultural soils in the EU are affected by erosion, low organic carbon, excess nitrogen and other minerals or secondary salinization. Soil compaction due to high pressure caused by the operation of heavy agricultural machines limits the looseness of soil and the availability of air in the soil. It limits the biological life of the soil, destroys its structure, and inhibits the penetration of water in the soil. This has a negative impact on reducing plant yields by 2.5–15%. Sustainable soil management and regeneration will restore their natural properties and reduce the food security crisis. If the approach to soil cultivation is changed to a more conscious and responsible one (through organic fertilization and limiting the excessive use of chemical plant production agents), by 2030, approximately 75% of all soils in each EU Member State will have significantly better fertility, i.e., with improved bio-physics-chemical properties of soils. It is estimated that reducing soil degradation and improving its fertility may bring global economic benefits of EUR 1.2 trillion per year.



Fertile soils are vital for farmers, crop yields and the entire agronomic ecosystem. Increasing soil fertility in the long term will contribute to more stable and higher-quality crops. The availability of healthy, fertile soils and sustainable land management are crucial to the development of bioeconomy as a whole. Measures to increase soil fertility can also reduce farm operating costs associated with the use of chemical crop inputs. Farmers can receive financial support for certain practices, under the Common Agricultural Policy (CAP) or the proposal for an EU carbon removal certification framework.

Progressing soil degradation also harms human health. Dust and greenhouse gas emissions emitted from agricultural production into the air and produced as a result of wind erosion increase respiratory and circulatory system diseases. Low-fertile soils with a compacted physical structure are less resistant to high temperatures during heat waves and have a lower ability to absorb pollutants. Contaminated soils also have a negative impact on food safety. In the European Union, 21% of agricultural soils are contaminated with cadmium, exceeding the permissible limits, which causes contamination of groundwater with this element.

Improving soil fertility is a key measure to increase soil resistance to unfavorable climate changes, such as droughts, high temperatures, and floods. Soil fertility depends on the level of organic matter, organic carbon and minerals in the soil, the ability to retain and filter water, as well as resistance to erosion. The soil's high organic matter content and water-holding capacity help prevent the risks of natural disasters. Soil bacteria and fungi, which are part of the biodiversity of fertile soils, are very important components of the soil microbiome and help plants reduce the negative effects of drought. In forests, fertile soils with functional water retention capacity increase tree growth and forest fire resistance. Forest fires degrade soil, leading to an increased risk of soil erosion, landslides and floods. Soils form very slowly. It takes 500 years or more to form a new layer of humus soil, 2.5 cm thick, but soil fertility can be improved by applying organic fertilizers, composts, organic matter, biochar and microbiological biopreparations.

As part of the European Green Deal, the European Commission adopted the 2030 Biodiversity Strategy, the Pollution Action Plan, the EU Climate Change Adaptation Strategy, and the EU 2030 Soil Protection Strategy. The latter sets out a long-term vision that by 2050 all soils will be in a good state of "health", and that biological protection, sustainable use and soil remediation will be widely implemented. The basic conditions necessary to achieve this goal include counteracting soil degradation and ensuring the protection and sustainable use of soil. The European Green Deal is a strategy that assumes the transformation of Europe into a competitive and modern climate-neutral economy. The aim of the European Green Deal is, among others:

reduction of greenhouse gas emissions by 55%,  
reduction of plant protection products by 50%,  
reduction of mineral fertilizers by 20%,  
increase in the area of organic crops by 25%.

The importance of soil fertility has also been recognized at a global level. The EU has made commitments in the international context of the three Rio Conventions on soils affected by desertification (UN Convention to Combat Desertification), mitigating climate change (UN Framework Convention on Climate Change), and protecting biodiversity (Convention on Biological Diversity).

By using soil fertility data at a sufficiently high level of detail, Member States and EU bodies will be better prepared to respond to and prevent natural disasters. Detailed data on soil health will be an invaluable resource for implementing climate change mitigation policies, also in relation to food security and the emphasis on human health and biodiversity. The proposed risk-based approach will enable standards to be set at the national level to leverage aid measures that reduce the risk of land degradation.

Applying sustainable management practices will help European Union Member States ensure high soil fertility and their capacity to provide many services that are essential for both human health and the environment. In doing so, they will be able to improve the security of ecosystems, the health and infrastructure of communities, and maintain existing and develop new sources of livelihood in these areas, e.g., agritourism, food markets, culture and well-being. Therefore, Member States must reduce the greatest threats to human health and the environment posed by soil pollution in order to contribute to the protection of human health, animal welfare, soil, water and air.

