



Flagship cluster fiche: THE DANUBE LAND AND SOIL NEXUS (DLSN)

1. RATIONALE AND OBJECTIVES

As shown by the JRC's Reference Report on the State of Soil in Europe, land and soil are an essential resource for key economic sectors such as agriculture development, energy production and construction, for environmental issues such as climate change and biodiversity, and for many cultural aspects. Soil functions in the Danube Region, as in many parts of Europe, are often taken for granted and perceived to be in abundance. Despite their fundamental role for the human well being, ecosystem functions and the economy, soil degradation generally goes unnoticed, as it is a slow process in which, unlike air and water, immediate dramatic effects rarely occur. However, land management, which is the prime pressure on the soil resource, is becoming an increasing societal challenge throughout the Danube Basin. This is especially important when one considers the economic consequences of land degradation and the trans-border implications of land loss – soil erosion in one country may result in reservoir siltation in another country downstream. Additionally, a loss of productivity in a country's agricultural soils puts increased pressure on arable land in another location – often, outside of the European Union. Land management is therefore a central issue to the Danube Region, especially since land is finite and, in human or policy timescales, is not renewable.

Sustainable and efficient use of soil resources should be encouraged in order to contribute to the balanced development of the Danube Region while preserving the environment and managing environmental risks such as floods and droughts. The Roadmap to a Resource Efficient Europe notes that, with respect to land, EU policies take into account their direct and indirect impact on land use in the EU and globally, and the rate of land take is on track with an aim to achieve no net land take by 2050; soil erosion is reduced and the soil organic matter increased, with remedial work on contaminated sites well underway.

The JRC is ideally placed to address these issues within the context of the Danube Strategy through current activities in the domain, active networks with key players and through its operation of the European Soil Data Centre (ESDAC)¹, which allowed the JRC to acquire a good understanding of the policy relevant data requirements.

Specifically, land and soil issues are, to a varying degree, a central theme of the four vertical priorities of the Danube Strategy.

- **Environment protection:**

Soil is an essential natural resource. The Danube Region is a major international hydrological basin and ecological corridor, heavily influenced by soil characteristics. The Region is an interrelated and interdependent ecosystem, incorporating a rich and unique flora and fauna. It is diverse, including not only the river Danube, its tributaries, lowlands and the remarkable delta, but also the major part of the Carpathian Mountains and part of the Alps.

¹ Further information on ESDAC is available at: <http://eussoils.jrc.ec.europa.eu/projects/danubesis/index.htm>



Land degradation affects the environment by modifying ecosystems and thereby reducing productivity and biodiversity. Loss of natural habitats puts pressure on fauna and flora, and affects the overall quality of environmental health. Fragmentation of ecosystems, land use intensification and urban sprawl are major pressures. The EU has set a target for halting biodiversity and ecosystems loss by 2020 by restoring ecosystem services and reconnecting habitats. The objectives of nature protection areas, such as Natura 2000 sites, can be achieved only with due respect to the ecological requirements of the whole region.

Erosion from arable lands causes a loss of nutrients, a decline in productivity (and associated economic costs) and water pollution. The build up of salts in the soil, especially in areas under irrigation is another area of concern. The Danube Region is also facing growing pressures on land-related risks related to the increased frequency of extreme weather phenomena and global climate change. The frequency and severity of floods, erosion, droughts, greenhouse gas fluxes and soil quality are likely to present major challenges in the coming years. The increasing industrialisation of the Danube is also contributing to local and diffuse soil pollution that are managed by a range of EU Directives (e.g. Nitrates, Seveso, Mining Waste or Environmental Liability) .

- ***Irrigation and agricultural development:***

Arguably, soil (together with water) is the critical resource for agriculture. Tackling pressures on soil functions caused by agriculture represents one of the main challenges to prosperity, food security and health in the Danube Region. In 2003, the reform of the EU Common Agricultural Policy (CAP) increased the opportunities for assisting in the implementation of land protection policies through an efficient use of Cross Compliance and of Agri-Environmental measures in the CAP. The Rural Development Plans for the Danube identifies the reduction of soil erosion and the preservation of soil organic matter as critical agriculture conditions. Addressing these pressures requires a basin-wide perspective and cooperation among countries in the Danube Region by taking account of the needs of farmers and consumers.

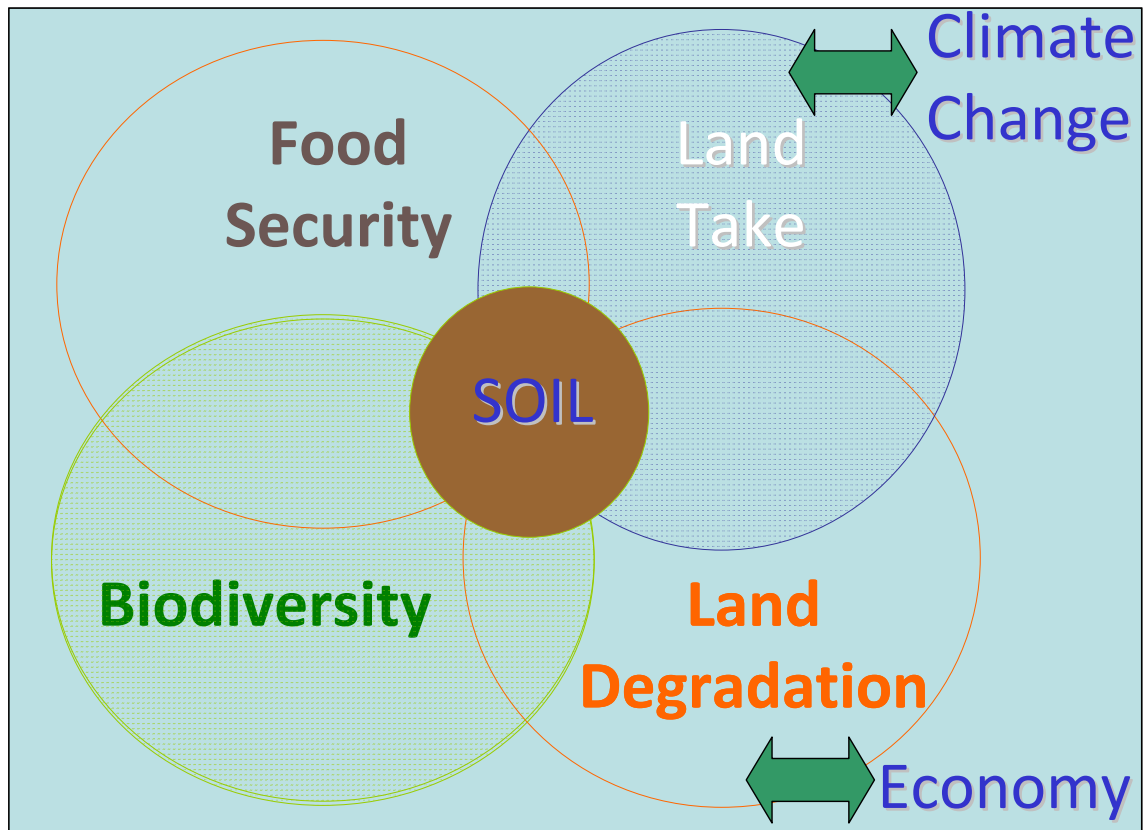
- ***Navigability:***

Navigation on the Danube and its main tributaries is impeded by seasonally varying water levels. Measures aiming to improve the navigability should consider sediment inputs resulting from soil erosion. The impact of soil sealing on water quantity is also a significant issue. The removal of the buffering capacity of soils leads to faster delivery of run-off to water bodies and channels leading to higher and more rapid flood event.

The dramatic changes in the Danube Region since 1989 have transformed society. In many countries, soil science and collection of policy relevant data have suffered from a lack of funding. The capacity for decision-making needs to improve through good planning and international cooperation based on a credible scientific base and understanding of best practices. To this end, targeted investment in people is needed through education and development of skills and competence to encourage and support growth.

The JRC is already a recognised player in soil and land issues in the Danube Region through the provision of scientific knowledge to help decision makers identify the best policy options. Based on its current expertise and through new activities, the JRC and its scientific partners can provide support in various manners, such as sampling exercises to assess soil quality, modelling tools to predict the impacts of land management on soil quality, erosion and greenhouse gas exchanges, and studies on the preservation of ecosystems.

The Danube Land and Soil Nexus



Soil is the cross-cutting theme between food security, land take, land degradation and biodiversity. External pressures such as economic development and climate change have a direct bearing on all of these issues, while not forgetting that soil status impacts climate and economic productivity of the land.

Related priorities of the JRC Scientific Support to the Danube Strategy initiative:

Environment protection
Irrigation and agricultural development
Navigability

Related priority areas of the EUSDR:

PA 1A - Mobility – Waterways (coordinated by Austria and Romania)
PA 04 - Water Quality (coordinated by Hungary and Slovakia)
PA 05 - Environmental Risks (coordinated by Hungary and Romania)
PA 06 - Biodiversity, landscapes, quality of air and soils (coordinated by Bavaria and Croatia)

Policy context and related legislation:

EU reference documents:

[EU Soil Thematic Strategy](#)
[EU Roadmap for a Resource Efficient Europe](#)
[Common Agricultural Policy Reform](#)
[EU Climate and Energy package](#)
[EEA State of the European Environment Report \(2010\)](#)

[JRC Reference Report on the state of soils in Europe \(2012\)](#)

[Soil Atlas of Europe, 2006 \(JRC\)](#)

[An Assessment of Land Productivity Dynamics, 2012 \(JRC\)](#)

[Overview of best practices for limiting soil sealing or mitigating its effects in EU-27](#)

International partner organisations:

Food and Agriculture Organisation of the UN (FAO)

United Nations Environment Programme (UNEP)

International Union for Conservation of Nature (IUCN)

International Commission for the Protection of the Danube River (ICPDR)

Visegrad Group

2. FLAGSHIP CLUSTER DESCRIPTION

The flagship cluster will deal with the following land and soils-related issues in the Region:

- Land and soil availability
- Land and soil quality
- Land and soil-related risks
- Preservation and restoration of above- and belowground ecosystems and biodiversity
- Harmonised data collection and monitoring
- Awareness raising and capacity building (*tbc*)

Flagship cluster structure:

The following Work Packages are proposed:

◆ Land and soil availability

Increasing demands on the services provided by land, both in Europe and globally, will lead to more intensive land uses, heightened pressures on soil functions and potential soil degradation. Land take for urbanisation and infrastructure projects coupled with climate change will exacerbate this trend. This matters to Europe because competition for land and water resources creates serious risks of geopolitical imbalances. Given such pressures at a global scale, Europe will be even more dependent in future on its finite land resources – which include some of the most fertile soils in the world – and on their sustainable use. Soil sealing (the permanent covering of soil with an impermeable material) and associated land take lead to the loss of important soil functions (such as water filtration and storage, and food production). Between 1990 and 2000, at least 275 hectares of soil were lost per day in the EU, amounting to 1,000 km² per year. Between 2000 and 2006, the EU average loss increased by 3%, but this is markedly higher in certain regions. In the period 1990-2006, 19 EU Member States lost a potential agricultural production capability equivalent to a total of 6.1 million tonnes of wheat. In this context, the following actions can be proposed:

- Targeted assessments of soil sealing and land consumption for the Danube river basin;
- Exchange of best practices towards minimising land consumption and a zero land take by 2050;
- An understanding of land productivity dynamics as an indicator of land degradation processes.

◆ Land and soil quality

Preservation of soil organic matter is a key concern in the Danube river basin. EU soils contain more than 70 billion tonnes of organic carbon, which is equivalent to almost 50 times our annual greenhouse gas emissions. However, intensive and continuous arable production may lead to a decline of soil organic matter. In 2009, European cropland emitted an average of 0.45 tonnes of CO₂ per hectare (much of which resulted from land conversion). The conversion of peatlands and their use is particularly worrying. Particular attention should be paid to the preservation of permanent pastures and the management of forests soils. In this context, the following actions can be proposed:

- Improved assessment of national soil organic carbon stocks, including peatlands;
- Assessment of change in soil carbon levels in agricultural soils in light of potential mitigation measures.

◆ Land and soil-related risks

A new model of soil erosion by water constructed by the JRC has estimated the surface area affected at 1.3 million km² in the EU. Almost 20% of these are subjected to a soil loss in excess of 10 t/ha/y. Erosion is not only a serious problem for soil functions, it also has an impact on the quality of freshwater, as it transfers nutrients and pesticides to water bodies. For example, agricultural losses of phosphorus exceed 0.1 kg/ha/y across much of Europe, but reach levels in excess of 1.0 kg/ha/yr in hotspots.

As an extreme form of land degradation, desertification results in a serious impairment of all soil functions. While there is still no scientifically-sound assessment at European level, one factor that contributes to desertification is an unfavourable trend in productive capacity. The JRC has recently published a report highlighting long-term changes in land productivity across Europe.

While naturally saline soils exist in certain parts of Europe, irrigation water – even if it is of high quality – includes minerals and salts that are gradually accumulated in the soil, causing salinisation. The continuing expansion of irrigation – with related problems of water scarcity and the increasing use of groundwater of marginal quality – accelerates salinisation, thereby affecting soil productivity. However, there are no systematic data available on trends across Europe.

Landslides are a major threat in mountainous and hilly areas across Europe (land abandonment being an aggravating factor), often producing serious impacts on population, property and infrastructure. Over 630,000 landslides are currently registered in national databases.

In this context, the following actions are proposed:

- Improved assessment of pan-Danube soil erosion levels in light of Rio+20 targets;
- Assessment of salinisation levels, in both irrigated areas and in naturally saline soils;
- Assessing land productivity dynamics in relation to degradation processes;
- Updated landslide inventory for the Danube Basin.

◆ Preservation and restoration of above- and belowground ecosystems and biodiversity

Soil biodiversity provides numerous essential services, including releasing nutrients in forms that can be used by plants and other organisms, purifying water by removing contaminants and pathogens, contributing to the composition of the atmosphere by participating in the carbon cycle, and providing a major source of genetic and chemical resources (e.g. antibiotics). However, data are scarce.

- Development of an indicator-based map showing a pressure on soil biodiversity;
- Development of the JRC's Digital Observatory for Protected Areas (DOPA)² methodology to NATURA 2000 sites across the Danube Basin.

² Further information on DPOA is accessible at: <http://dopa.jrc.ec.europa.eu/>

◆ **Harmonised data collection and monitoring**

Current assessments of the state and trends of soil characteristics across Europe are difficult due to a lack of current and harmonised data and monitoring systems. Policy makers require up-to-date information for effective decision-making.

Deposition of acidifying air pollutants (e.g. ammonia, sulphur dioxide and nitrogen oxides) contributes to soil acidification, which lowers the pH of the soil, thereby modifying the soil ecosystem, mobilising heavy metals and reducing crop yields. While air deposition models predict a significant improvement in the period 1990-2010, the situation for non-forested soil is not known, as there is no systematic monitoring of soil acidification across Europe.

Agriculture is highly dependent on soil fertility and nutrients availability. For example, it used 20-30 million tonnes of phosphorus annually over the last thirty years, largely coming from outside the EU. The use of mineral fertilisers and organic waste disposal can lead to increased concentrations of heavy metals in soils.

The JRC's LUCAS (Land Use/Cover Area) Topsoil Database is an excellent model for the collection of harmonised pan-European data on land use and soil. It contains information on land management practices, soil characteristics, soil nutrient and heavy metal levels for EU countries. The expansion of these data to non-EU countries of the Danube Region would lead to a unique resource to assess the state of soil in the Danube Basin.

It is difficult to quantify the full extent of local soil contamination, as the vast majority of EU Member States lack comprehensive inventories, although this is covered by the proposed Soil Framework Directive. The JRC has recently completed a new formal assessment of contaminated sites through the EIONET-SOIL network.

- Development of harmonised soil sampling programme for non-EU countries in the Danube river basin based on the JRC's LUCAS methodology;
- Development of benchmark soil sites to assess changes in soil properties;
- Focused collection of soil contamination data for Danube Region.

◆ **Awareness raising and capacity building (tbc)**

Awareness raising initiatives (e.g. events, publications, public campaigns), training for young researchers, integration of soil and soil protection aspects in EU-funded information and training events, and specific soil deliverables for the rotating Presidencies of the Council (e.g. information material on national soil types) are just a few areas where the message to protect soils can be presented to a broader, non-scientific audience. The JRC plans to build on previous experiences through:

- Focused summer schools on target young scientists and policy/decision makers (in combination with FAO Regional Centre);
- Development of targets awareness raising material for entire Danube Basin;
- Awareness raising seminar in conjunction with European Network for Soil Awareness (ENSA) and European Land and Soil Alliance³.

³ See p.51 of the Action Plan on the EU Strategy for the Danube Region.(SEC(2010)1489).

3. OUTPUTS AND BENEFICIARIES

Products:

- Policy relevant data products describing soil functions and pressures on land and soil
- Awareness raising activities, including awareness raising materials, seminars and summer Schools

Potentially interested actors and/or beneficiaries of the research results:

EU institutions and bodies
National and regional governments of the Danube Region
Other stakeholders of the Danube Region

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