

OPINION

A 1 billion euro mission: A Soil Deal for Europe

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Abstract

Soils have achieved prominence in the political agenda of the European Commission with the proposal for a Soil Monitoring Law and the ambitious Soil Mission research framework. The EU Soil Observatory (EUSO) used the latest state-of-the-art pan-European datasets to propose a preliminary assessment of soil health in the EU based on 18 soil degradation proxy indicators. The body of knowledge will soon be enriched thanks to the investment of 1 billion euros towards the Mission 'A Soil Deal for Europe', which has the ambition to promote the development of new harmonized bottom-up and top-down soil health indicators. New data and knowledge are also anticipated through the national soil monitoring schemes to support the implementation of the Soil Monitoring Law. We present the Soil Mission roadmap towards assessing and achieving soil health in the EU by 2030 to meet Green Deal objectives. We introduce the EUSO Soil Health Dashboard, a soil degradation indicator tool using soil health indicators developed by the European Soil Data Centre (ESDAC) (2012–2023) that will contribute to Soil Monitoring Law assessments.

KEYWORDS

land degradation, soil health, soil mission, soil monitoring law

Since Plato first observed the effects of land degradation in Greece's formerly lush hills, nearly 2500 years ago, Europe, as other parts of the world, continues to struggle with accelerated soil degradation. Human-induced land degradation is a global threat to food production, climate change and ecosystem services provision. A recent assessment indicates that 60%–70% of the soils in the European Union (EU) are unhealthy (Veerman, 2023), which means that crop productivity levels and other soil functions like climate and water regulation are impaired. The socioeconomic impact of soil mismanagement is also considerable, with soil erosion alone estimated to cost the global economy \$8 billion annually in terms of GDP (Sartori et al., 2019), and impacting poorer countries disproportionately (Borrelli et al., 2017). In contrast, the total cost of land degradation

in the EU, and of the decreased provision of ecosystem services caused by it, was estimated at €50 billion per year (SML, 2023).

Over the last two decades, the EU has put in place a number of policies for agro-environmental protection, such as the Soil Thematic Strategy (2006), and for the greening of the Common Agricultural Policy (2013). Since 2020, the EU Green Deal has set an ambitious roadmap to make the EU the first carbon-neutral continent with a modern, competitive and resource-efficient economy (Čavoški, 2020). As part of the EU Green Deal, the EU has ranked soil protection high on the policy agenda. In 2021–2022, the European Commission (EC) adopted the EU Soil Biodiversity Strategy 2030, the Zero Pollution Action Plan and the EU Climate Adaptation Strategy,

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followed by the proposal for a Soil Monitoring Law (Panagos et al., 2022). In July 2023, the EC proposed the Soil Monitoring Law to put in place a solid and coherent monitoring framework and make sustainable soil management a norm.

Over the same period, the EC also adopted an ambitious framework including five EU Research and Innovation Missions (namely ‘Cancer’, ‘Adaptation to Climate Change’, ‘Ocean Seas and Water’, ‘Climate Neutral and Smart Cities’ and ‘A Soil Deal for Europe’; Mazzucato, 2021). The Soil Mission aims to set up 100 Living Labs to promote sustainable land and soil management in urban and rural areas to achieve the

Highlights

- The EU Soil Observatory (EUSO) developed the first Soil Health Dashboard.
- 60-70% of EU soils are affected by one or more soil degradation processes and can be considered unhealthy.
- 100 Living Labs will promote sustainable land and soil management in urban and rural areas.
- The bottom-up mapping will include soil health indicators developed by Soil Mission projects.

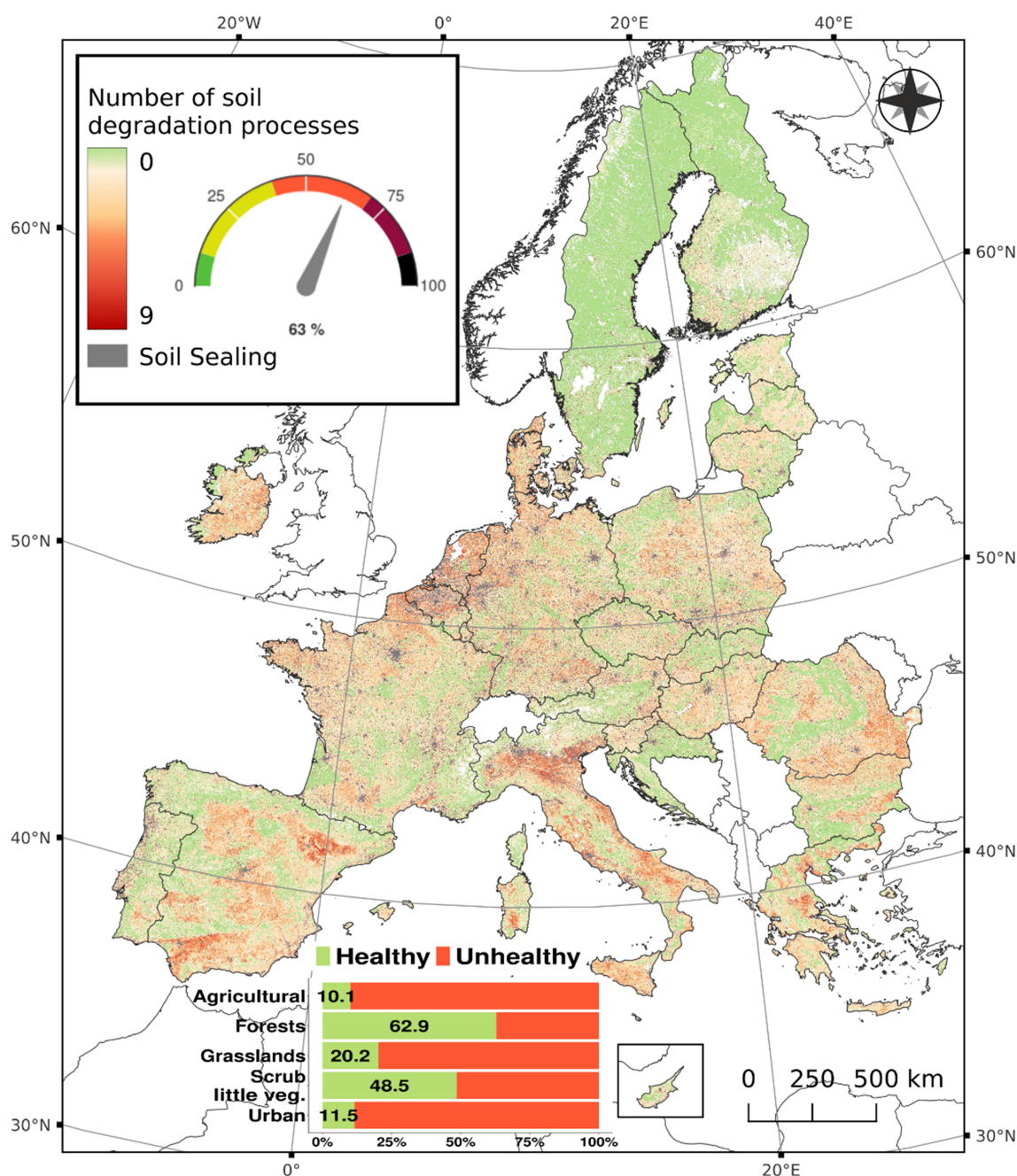


FIGURE 1 Convergence of evidence of soil degradation in the EU according to the Soil Health Dashboard.

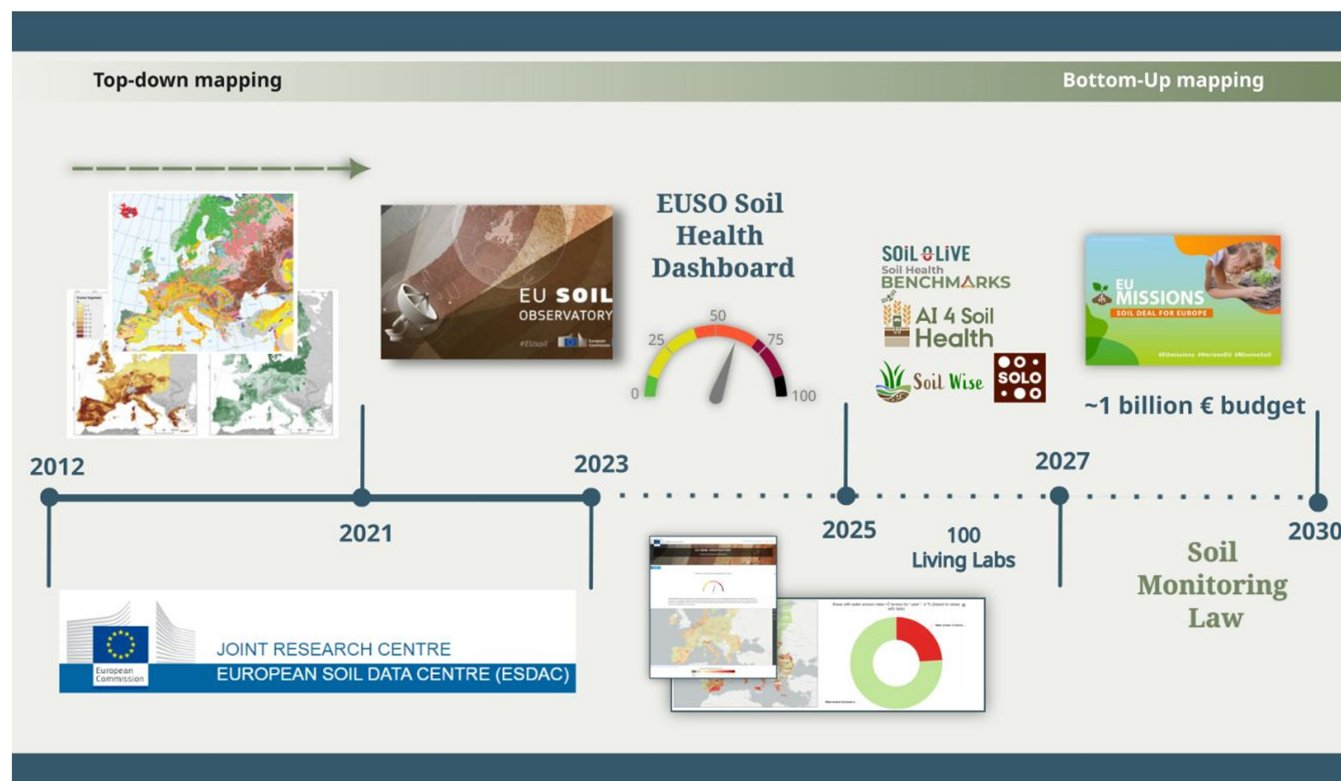


FIGURE 2 Roadmap towards assessing soil health in the EU by 2030 achieving the Green Deal objectives. The top-down mapping was performed with indicators developed by the European Soil Data Centre (ESDAC) (2012–2023). This endeavour resulted in the EUSO Soil Health Dashboard (2023). Such efforts will contribute to Soil Monitoring Law assessments by 2030.

EU's policy objective to have all soils healthy by 2050 (EC, 2023). The Soil Mission has already funded projects totalling more than €250 million in 2021–2022 and will continue to do so with an even larger funding allocation for the 2023–2024 HORIZON Europe calls. With an estimated investment of around €1 billion until 2028, funded research projects under the Soil Mission are expected to reverse soil degradation through action on the ground. This will be underpinned by the development and monitoring of a set of indicators. The goal is to develop a soil health programme based on a framework and roadmap that will translate globally, which is an ambition of the UN's Intergovernmental Technical Panel on Soils (ITPS) (Wall & Six, 2015). Moreover, the Soil Mission will propel the EU's goal to manage all land in more sustainable ways, both across the EU and globally. Action will be centred around 100 Living Labs, real-world environments and settings where practitioners, researchers and other stakeholders (e.g., farmers, foresters and land owners) can collaborate to generate and test new solutions for sustainable soil management (Bouma, 2022).

Soil health is a holistic concept that seeks to gather sufficient evidence to declare a soil healthy; it is often a good conversation starter with farmers or foresters, posing the question: 'Is your soil healthy, and can it be

improved'? However, from the Mission perspective, especially at a pan-European scale, policymakers need to know where to target and prioritize action. By identifying the magnitude and location of soil degradation, targeting and prioritization for remediation can be most easily achieved. Moreover, by monitoring for known soil degradation threats, the absence of any threat could, by elimination, be considered to render a soil healthy for the specific location and conditions. In line with the latter, a soil degradation indicator tool (Figure 1), defined by the EU Soil Observatory (EUSO), was developed in support of the Soil Mission, which will continue to be refined.

Over the past 12 years, the EC's Joint Research Centre has performed several top-down harmonized modelling assessments on soil parameters and processes across the EU (Figure 2). Most of these assessments were based on LUCAS—a European monitoring programme of soil state and change at the continental level (Orgiazzi et al., 2018). A 63% share of unhealthy soils in the EU was identified through combined evidence on soil health and threats derived from 18 indicators of soil degradation processes, according to the EUSO Soil Health Dashboard (<https://esdac.jrc.ec.europa.eu/esdacviewer/euso-dashboard/>) (Figure 1). Those indicators have been proposed by the

EU policies (Soil Monitoring Law, Soil Mission Implementation plan) and have broad agreement and application throughout the soils community (Bünemann et al., 2018). Soil degradation is associated with extensive areas of agricultural and urban environments, while almost two-third of forests and half of semi-natural areas do not indicate any threat to soil health.

This new threat-based approach (Figure 2) reveals the magnitude of the task before the Soil Mission and informs both land managers and policymakers of the issues to be investigated and ultimately resolved. The Soil Mission is a promising step that represents an important investment in the soil resource; it is often overlooked, but vital to societal health and well-being through the production of healthy nutritious food and the sustainment of vibrant, healthy ecosystems. The success of the Mission will be measured by our ability to realize action on the ground (bottom-up approach and 100 Living Labs, as in Figure 2) and turning the soil degradation indicator map from red (unhealthy) to green (healthy).

AUTHOR CONTRIBUTIONS

Panos Panagos: Conceptualization; investigation; funding acquisition; writing – original draft; methodology; validation; writing – review and editing; formal analysis; project administration; data curation; supervision; resources; visualization. **Pasquale Borrelli:** Data curation; formal analysis; validation; visualization; writing – review and editing; writing – original draft; investigation. **Arwyn Jones:** Conceptualization; investigation; methodology; formal analysis; data curation; writing – review and editing. **David A. Robinson:** Investigation; writing – review and editing; writing – original draft; methodology.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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