



# Soil Biodiversity Research and Policy in the EU

POSITION PAPER



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# **Investigating the Current Status of Soil Biodiversity Research and Policy in the EU**

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## 1. Soil Protection and Why it Matters

In its traditional meaning, soil is a natural living medium which is absolutely crucial for life on earth. It is needed for the growth of plants, and it is home to a multitude of micro-organisms, such as bacteria and fungi, and micro-fauna, like earthworms and termites (FAO, 2021a). Soils are also defined as the extreme outer part of the Earth's crust, which develops through the effects of chemical, physical, and biological processes over hundreds to thousands of years. Since they are regarded as a finite resource (ISRIC, 2021), soil degradation is not reparable within a human lifespan. In fact, depending on a range of factors like climate and vegetation, it can take up to 1000 years to produce 1 cm of soil. Currently, drylands account for 40 % of the world's land mass, causing biodiversity habitat loss and extreme soil deterioration (FAO, 2021a). Moreover, about 1/3 of soil is no longer available for food production, hence it is of utmost priority to preserve what is still accessible of this important resource (European Commission, 2021a).

The role of soils in the Earth's ecosystem is key in delivering valuable services, starting from the production of food, as currently 95 % of what we consume comes from soils. They are also essential in providing raw materials, as well as energy from carbon compounds to facilitate the growth of life of the soil biota. Healthy soils can help mitigate climate change by storing carbon and reducing greenhouse emissions into the atmosphere. Furthermore, soils act as water purifiers, they prevent floods and droughts, and they recycle nutrients essential to our ecosystem. Finally, soil health is fundamental not only for human health, but also for the safeguard of both below ground biodiversity, since more than 10 billion living microorganisms can be found in just a handful of soil, and above ground biodiversity, including wildlife and domesticated livestock (European Commission, 2021a).

### 1.1. Soil Biodiversity

The Convention of Biological Diversity (United Nations, 1992) defines biological diversity as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and



of ecosystems”. For the purpose of this paper, we will refer to soil biodiversity as the diversity of living organisms in the soil (Atlas of Soil Biodiversity, 2010). This is key in the provision of both ecosystem goods and services. Among the ecosystem goods provided by soil biodiversity there are: food production, fibre production, fuel production, the provision of clean water and of secondary compounds, such as pharmaceutical and agrochemicals (ESDAC, 2021).

Soil biodiversity provides the following ecosystem services (ESDAC, 2021):

- Driving nutrient cycling and regulation of water flow and storage;
- Regulation of soil and sediment movement and biological regulation of other biota (including pests, diseases, and above ground diversity);
- Soil structure maintenance; and
- Detoxification of xenobiotics and pollutants and regulation of atmospheric composition.

## 2. Main Threats to Soil Biodiversity

Human behaviour can greatly impact the state of soils. By employing farming practices such as low or no till, crop diversity and decreasing in the use of fertilisers and pesticides, the average crop yields can increase by 58 % (European Commission, 2021a). Pesticides represent a serious hazard to both soil environment and human health because they remain in the soil system for a considerable period. As a consequence, pesticides and their derivatives negatively impact the functions of microbes and cause imbalance of soil fertility (Meena, R. S. *et al.*, 2020). Inappropriate management and overexploitation easily lead to soil degradation because of erosion, acidification, salinisation and leaching of nutrients. As previously mentioned, this phenomenon already affects 33 % of soil worldwide, making it unavailable for food production. In Europe, and especially in the Mediterranean region, the most common source of soil degradation is water erosion, a phenomenon affecting around 16 % of the total area (European Commission, 2021a).

In 2016, the European Commission’s JRC published an article aimed at mapping the potential threats to soil biodiversity in the EU (Orgiazzi *et al.*, 2016). In



particular, three main elements of soil biodiversity were assessed: soil microorganisms, fauna, and biological functions. A list of 13 potential pressures was proposed to 107 soil experts from 21 countries in order to obtain a knowledge-based ranking of threats. Based on available literature, the potential risks to soil biodiversity that were laid out by the authors are the following: GMOs use, habitat fragmentation, industrial pollution, nuclear pollution, soil sealing, human exploitation, climate change, land use change, soil organic matter decline, soil salinisation, soil compaction, soil erosion and invasive species. The results were used to create normalised indices of threats and to create maps, which allowed to identify potential risks in the European region. Those maps were then compared with spatial distribution of land cover types, biogeographic regions, and protected areas to determine the most sensitive soils.

*Figure 1* shows that for all the three elements of soil biodiversity, GMOs use was considered the threat with the least potential, while intensive human exploitation (intensive agriculture, indiscriminate use of agrochemicals, inappropriate disposal of municipal waste) was regarded as the highest pressure. This does not mean that GMOs are altogether risk-free, but only that there are other more pressing threats. The analysis also finds that most European countries feature the presence of soils with high level of risk, while only five countries had more than 40 % of their surface with low or low-moderate risk. In particular, agricultural lands had the highest levels of threats of soil biodiversity. In contrast, the lowest level of risk was registered in areas covered by forests. It follows that, taking into account the seven European biogeographical regions, Eastern Europe have up to 10 % of their soils at high level of threat, while the boreal region was exposed to the lowest threat.



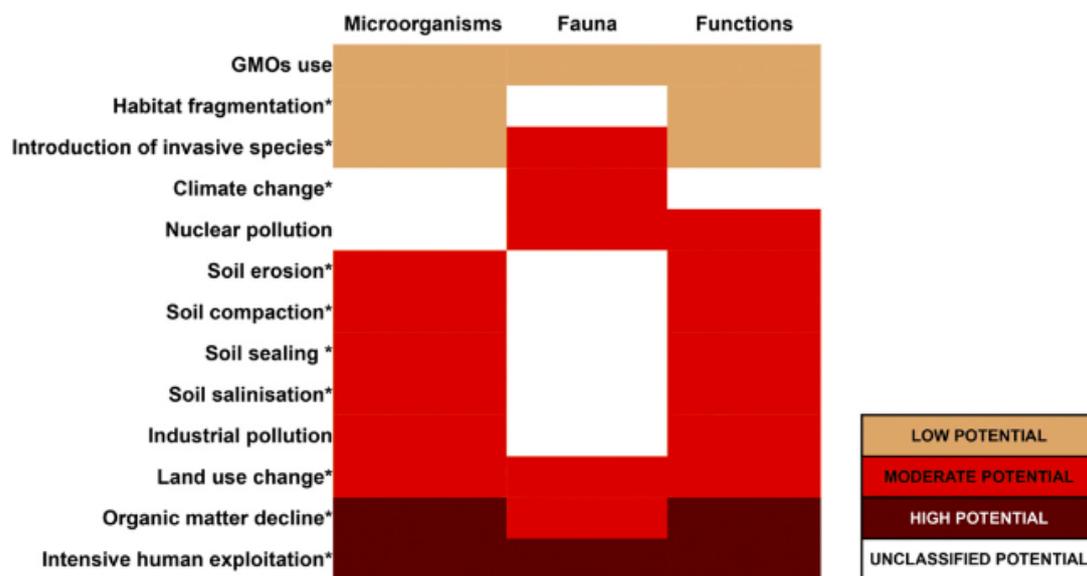


Figure 1. Classification of potential threats to soil biodiversity (Orgiazzi et al., 2016)

### 3. EU Policies to Protect Soils and Soil Functions

In June 2021, a Renew Europe webinar, involving representatives from the European Commission, European Environmental Agency, and businesses in the field, discussed the role of soil in the European Green Deal. The event highlighted that, despite soils being the foundation for sustainable productivity, too little attention has been paid to them so far in terms of policy frameworks. Therefore, upcoming proposals will require a long-term oriented approach, as well as a legal framework, which will ensure that the rights under the ownership of the small holder farmers are not only protected, but they are also provided the tools to have sustainable livelihoods.

Soil protection's importance on the policy agenda this year was further reinforced during the intervention of the Commissioner for the Environment, Oceans and Fisheries, Virginijus Sinkevičius. The Zero pollution action plan for air, water, and soil, recently adopted in May, contains several proposals against soil contamination, guidelines for a passport for excavated soils and a watch list for soil contaminants (European Commission, 2021b). Furthermore, in the upcoming months, the Commission will put forward a new EU Soil Strategy. This will establish an overarching policy framework and a concrete pathway to address soil degradation in a comprehensive way and will help fulfil EU and international



commitments on land degradation neutrality (European Commission, 2021c). By the end of 2021, the Commission will also put forward a legislative proposal for the EU binding nature restoration targets, which will aim at restoring degraded ecosystems including soil and soil ecosystem features (European Commission, 2021d). Finally, the Mission area on soil health and food within the Horizon Europe Research Programme, beginning this year, intends to provide relevant resources to develop knowledge and solutions to make soils healthy (European Commission, 2021e).

The Parliament's resolution on soil contains an impressive number of concrete calls on the Commission to act on soil protection, sustainable soil management and restoration of degraded soils. It also rightly highlights the importance the healthy soils have for landowners, farmers and foresters as primary actors of soil management and whose activity relies almost entirely on soil health. Given that soil and land degradation primarily affect farmers and foresters, cooperation is essential. There is a need to establish a strong framework of incentives and measures to support farmers and foresters in the efforts on sustainable soil management. It is also necessary to maintain and reinforce the dialogue to strengthen the financial incentives, the support for research and innovation, as well as adequate training for all land uses. The Commission is supporting farmers and foresters through the Common Agricultural Policy (CAP), the Life Programme and the EU Regional Policy, for instance. However, soil protection also features in the recovery and resilience plans. This is because of the role that healthy soils play for the resilience of our communities to economic shocks, as well as to climate change. Therefore, securing the necessary funding will be one of the crucial factors for the success of the implementation of soil protection (Renew Europe, 2021).

The Commission's commitment on working both on a new EU Soil Strategy, as well as on legally binding restoration targets for degraded systems was also highlighted by Florika Fink-Hooijer, Director General of the DG Environment of the European Commission. The importance of having a legal framework at EU level stems from the need to give soil the same protection as to water and air, while complying with the subsidiarity principle. This is even more imperative during the UN Decade on



Ecosystem Restoration. Today, soil legislation in the member states is very uneven, and very few members have a comprehensive framework covering soil protection, restoration, sustainable use, and monitoring. Moreover, in member states where pressures on soil are high, there are often fewer policy instruments to protect those soils. As a consequence of the playing field not being levelled, economic operators that use the soil have to follow different rules and incur different costs. The Commission now aims to fix the missing link between the Green Deal priorities: biodiversity, climate change, food security and zero pollution (European Commission, 2021f). The importance of soil protection and political expectations to act are high. Therefore, common rules and a clear policy framework are needed, as they will also help member states regions and stakeholders to use the available EU funds more effectively.

## **4. From the 2006 Thematic Strategy for Soil Protection to the new EU Soil Strategy**

### **4.1. The 2006 Thematic Strategy for Soil Protection**

As mentioned in the previous section, there is at present no common EU policy on soil protection. For this reason, in September 2006, The European Commission put forward the “Thematic Strategy for Soil Protection”, which included a new proposal for a Soil Framework Directive (Glæsner *et al.*, 2014). The strategy revolved around preventing further soils degradation, while restoring the degraded soils to the level of its intended use (European Commission, 2006). Meanwhile, the Soil Directive was built around four pillars (EEB, 2017):

1. Estimating how different sectors (industry, agriculture, etc...) affect soil quality and suggest measures to integrate soil protection in these areas
2. Determine which areas are at risk of soil erosion, decline of organic matter, salinisation, acidification, compaction, or landslides.
3. Design national strategies to meet these challenges and restore contaminated sites.
4. Gather data on the condition of soils through a commonly agreed EU approach.



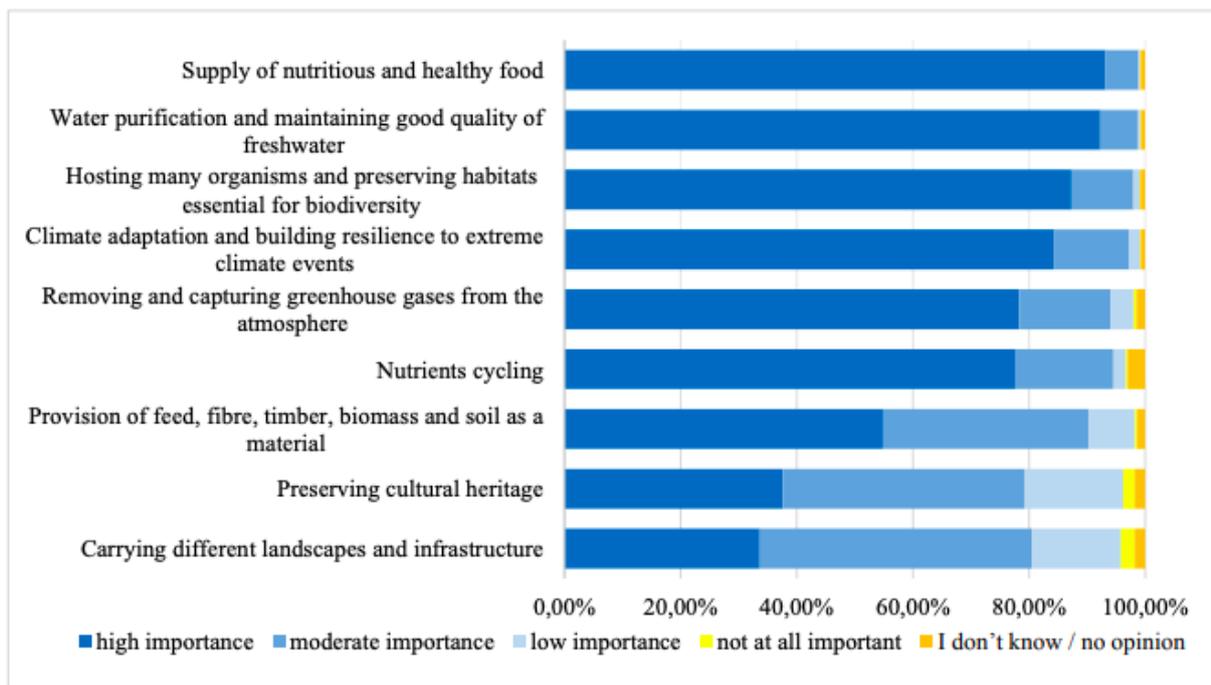
Ultimately, the proposal failed to be adopted by the EU Council of Environment Ministers in December 2007, due to the resistance of Germany, the UK, France, Austria, and the Netherlands. The opposition was based on a series of motifs, namely: the incompatibility of the proposal with the subsidiarity principle, the excessive amount of bureaucracy required and the high expenses that would have resulted from its implementation (EEB, 2017). Whether or not these claims stand up to scrutiny, it is important to acknowledge that the Directive was far from perfect. First and foremost, for the purpose of this paper, we notice that no objectives concerning soil biodiversity were included in the 2006 proposal. Furthermore, the soil quality goals that were suggested were neither appropriately defined, nor time bound. The proposal also gave too much room for decision to members state and offered no real incentives for changing land use practices. As part of the EU Biodiversity Strategy for 2030, the Commission has announced the update of the 2006 Thematic Strategy for Soil Protection. Looking to improve its goals will be crucial for meeting the objectives of the European Green Deal.

#### **4.2. The new EU Soil Strategy**

The new EU Soil Strategy, expected to be published after the summer of 2021, will address soil and land degradation in a comprehensive way to help achieve land degradation neutrality by 2030 (European Commission, 2021c). One of the main differences from the 2006 Thematic Strategy for Soil Protection is the importance given to biodiversity restoration. In particular, in October 2020, the Council of the European Union stressed the importance of the commitment to protect both soils and soil biodiversity. Without any actions, the achievement of the Green Deal and international objectives would in fact be jeopardised (European Commission, 2021c). Soil and land degradation is a severe problem for soil biodiversity in the EU. This was acknowledged not only in the Roadmap for the New Soil Strategy, where it was highlighted that, in recent decades, intensive land management has negatively impacted soil biodiversity, such as the species richness of earthworms, springtails and mites, but also in the consultations with stakeholders.



In terms of the categories of respondents, the recently concluded online consultations mainly involved individual EU citizens, while 30 % of inputs came from the agriculture sector, followed by environment and nature protection with about 17 % (European Commission, 2021g). As shown by *Figure 2*, 90 % of respondents considered “supply of nutritious and healthy food” as the most important ecosystem service provided by soil. The second most important service is “water purification and maintaining good quality of freshwater”, while the third is “hosting many organisms and preserving habitats essential for biodiversity”. Furthermore, *Figure 3* shows how the respondents consider “land take and soil sealing” (67 %) and “loss of soil biodiversity” (60 %) as the most acute degradation processes. Interestingly, business associations considered instead those two as the least acute degradation processes in their country (European Commission, 2021g).



*Figure 2. Question "Which soil ecosystem services do you consider as the most important?" (European Commission, 2021g)*



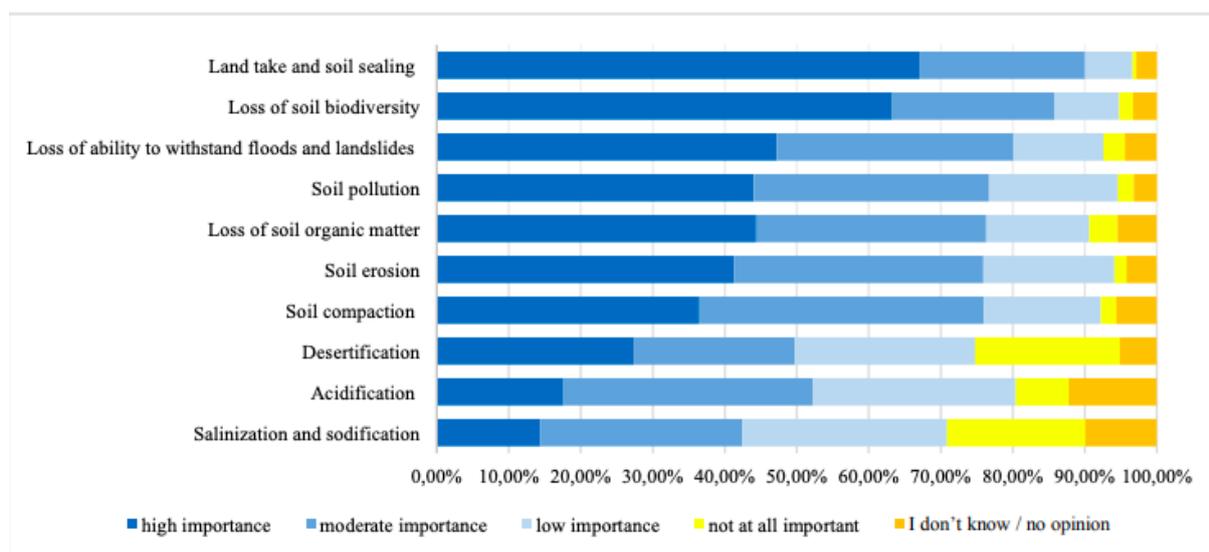


Figure 3. Question "To the best of your knowledge, which of the following soil and land degradation processes are the most acute in your country?" (European Commission, 2021g)

The consultations with stakeholders have highlighted how the protection and enhancement of soil biodiversity should be a key part of the new Soil Strategy. Therefore, this should be expected to have high priority in the drafting of the new strategy. The initiative aims to achieve its goals through a range of aspects, including funding instruments, developing knowledge and research, monitoring soil quality, communication, and international cooperation (European Commission, 2021g). Section 2 of this paper has emphasised the high potential threat of intensive human exploitation on soil biodiversity, therefore, the adoption of more sustainable soil management practices and behavioural change should be at the forefront of this initiative. The new EU Soil Strategy will coordinate with other Green Deal initiatives, such as the Zero Pollution Action Plan, the EU Biodiversity Strategy for 2030 and the Farm to Fork Strategy. Most importantly, the Soil Strategy will need to be complemented by the legally binding EU nature restoration targets which will be proposed by the Commission by the end of 2021.

## 5. The European Green Deal and the Protection of Biodiversity

Within the European Green Deal, the safeguard of soil biodiversity will be primarily addressed by the new EU Soil Strategy. However, there are several other initiatives that encompass this pivotal objective, for instance: the Zero Pollution Action Plan, the Biodiversity Strategy for 2030, the Farm to Fork Strategy and the Organic Action



Plan. The table below summarises these four initiatives, both including their long-term objectives and more specifically how biodiversity targets are incorporated in those initiatives.

STRATEGY / PLAN	LONG-TERM OBJECTIVES	BIODIVERSITY TARGETS
<b>Zero Pollution Action Plan</b>	To reduce air, water and soil pollution to levels no longer considered harmful to health and natural ecosystems, thus creating a toxic-free environment by 2050 (European Commission, 2021b).	<p>By 2030, the EU should:</p> <ul style="list-style-type: none"> <li>• Reduce by 25 % the EU ecosystems where air pollution threatens biodiversity</li> <li>• Improve soil quality by reducing nutrient losses and chemical pesticides' use by 50 %</li> </ul>
<b>Biodiversity Strategy for 2030</b>	To put Europe's biodiversity on the path for to recovery by 2030 for the benefit of people, the planet, the climate, and our economy. The ultimate vision, by 2050, is for all of the world's ecosystems to be restored, resilient and adequately protected (European Commission, 2021h).	<p>By 2030, the EU should:</p> <ul style="list-style-type: none"> <li>• Expand protected areas to 30 % of the EU's land and sea</li> <li>• Restore nature, including soil ecosystems, and ensure its sustainable management across all sectors</li> <li>• Strengthen the EU biodiversity governance, framework, knowledge, research, financing, and investments</li> <li>• Deploy EU external actions to support biodiversity globally</li> </ul>



<p><b>Farm to Fork Strategy</b></p>	<p>To make food systems fair, healthy, and environmentally friendly in order to meet the goals of the European Green Deal and to achieve the United Nation's Sustainable Development Goals (SDGs) (European Commission, 2021i).</p>	<p>This strategy aims to accelerate the EU's transition to a sustainable food system that should reverse the loss of biodiversity.</p> <p>By 2030, the EU should:</p> <ul style="list-style-type: none"> <li>• Reduce by 50 % the use and risk of chemical pesticides, which contribute to soil, water, and air pollution</li> <li>• Reduce nutrient losses by at least 50 %, while ensuring no deterioration on soil fertility</li> <li>• Reduce fertiliser use by at least 20 %</li> </ul>
<p><b>Organic Action Plan</b></p>	<p>To achieve the European Green Deal target of 25 % of agricultural land under organic farming by 2030. The Organic Action Plan falls under the Farm to Fork Strategy (European Commission, 2021j).</p>	<p>This plan aims to improve the contribution of organic farming to sustainability, through actions such focused on enhancing genetic biodiversity and increasing yields.</p> <p>Organic farms already hold 30 % more biodiversity than land farmed conventionally due to the absence of chemical pesticides, synthetic fertilisers, and GMOs.</p>

## 6. EU Research on Soils

Research and innovation will play a key role in the efforts of the EU's efforts to become the first climate-neutral continent by 2050. Therefore, under the European Green Deal, the Commission has made available 1€ billion to respond to the climate crisis. In terms of research and innovation on soils matter, both the new EU Soil



Strategy and the Biodiversity Strategy have highlighted the importance of developing new knowledge and tools that can further enhance soil's productive and ecosystem functions by optimising its biological, chemical, and physical properties (European Commission, 2021k). In particular, we focus on three different funding opportunities that are available for soil research and innovation, namely: Horizon Europe, Horizon 2020, and the LIFE programme.

Starting in 2021, Horizon Europe is the EU's next research and innovation programme, with over 35 % of it contributing to climate objectives. As underlined by Commissioner Sinkevičius, the Mission area on soil health and food within the Horizon Europe Research Programme will provide relevant resources to develop knowledge and solutions to make soils healthy (European Commission, 2021e). Furthermore, the mission will raise awareness on the importance of soils and soil biodiversity by engaging with EU citizens. The preparatory phase for Horizon Europe began in November 2020 and will last a maximum of 12 months, at the end of which the mission strategy will be assessed and approved. The interim report proposed the mission "Caring for Soil is Caring for Life", targeted at making at least 75 % for all soils in the EU healthy for food, people, nature, and climate by 2030.

A second important funding opportunity is Horizon 2020, EU's biggest R&D programme ever, with around €80 billion of funding available over 7 years, from 2014 to 2020. Within this initiative, two notable ongoing projects focused on soil biodiversity are SOILGUARD and SoildiverAgro. The former aims to create a conceptual and analytical framework with the potential to become the global standard for future assessments of soil biodiversity status (European Commission, 2021l). The latter initiative, instead, is targeted on the adoption of new management practices that enhance soil genetic and functional biodiversity to reduce the use of external inputs, while increasing crop production and quality, the delivery of ecosystem services and the EU agricultural stability and resilience (European Commission, 2021m).

Finally, the LIFE programme was created in 1992 and is the EU's funding instrument for the environment and climate action. On 13 July, calls for proposals opened under the new LIFE programme 2021-2027. Its financial envelope will be



implemented through four sub-programmes. Particularly relevant to the topic of this paper, the Nature and Biodiversity sub-programme. This aims to protect and restore Europe's nature and to halt and reverse biodiversity loss. Therefore, this sub-programme especially funds nature conservation initiatives in the areas of biodiversity, habitats, and species. It will also contribute to the management of the Natura 2000 network and in achieving the objectives of the Biodiversity Strategy for 2030 and the later new EU Soil Strategy as part of the EU Green Deal (European Commission, 2021n).

## Conclusion

The current lack of a comprehensive EU policy framework for the protection of soil and soil biodiversity has underlined the urgent need to update the 2006 Thematic Strategy for Soil Protection to meet the objectives of the European Green Deal. From the targets and objectives of the new EU Soil Strategy, but also of the Biodiversity Strategy for 2030, Zero pollution Action Plan and Farm to Fork Strategy, we can confirm that the protection of soil biodiversity is well reflected in the scope of these initiatives. At the same time, EU funded research on soils and soil biodiversity also follows the same path. Within the Horizon Europe Research Programme, as well as Horizon 2020 and the LIFE programmes there are a number of projects which intend to provide relevant resources to develop knowledge and solutions to make soils healthy. The rest of 2021 will be decisive in translating the European Commission's commitments into clearly defined policy frameworks. While these important initiatives are undergoing discussions and consultations, Europe is facing a summer of floods, fires, and extreme heat. The IPCC's latest climate report has indicated that the pathway to limiting global warming to 1.5° C by mid-century is narrow, but still achievable. As this report has highlighted, healthy soils can, among other functions, help mitigate climate change by storing carbon and reducing greenhouse emissions into the atmosphere. The importance of soil protection and political expectations to act are high. Therefore, establishing common rules and a clear policy framework is imperative, as this will also help member states regions and stakeholders to use the available EU funds more effectively, and to achieve the European Green Deal priorities by 2050.



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