



NBSOIL

Nature-Based Solutions
for Soil Management

NBSOIL Theory of Change: Initial outline

Deliverable 51 (D7.1)

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Author(s)	Javier Montellano López	
Contact	javier@revolve.media	
Reviewer	Grzegorz Siebielec (IUNG)	
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¹ R=Document, report; DEM=Demonstrator, pilot, prototype; DEC=website, patent filings, videos, etc.; OTHER=other

² PU=Public, CO=Confidential, only for members of the consortium (including the Commission Services), CI=Classified



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The Nature-Based Solutions for Soil Management – NBSOIL – project is a four-year EU funded project coordinated by the Institute of Soil Science and Plant Cultivation in Poland. It aims to create and test a learning pathway for existing and aspiring soil advisors – providing them with the necessary tools and knowledge to develop a holistic and nature-based solutions approach to soil.



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1. Imagining the Next Generation of Soil Advisors

We envision the next generation of soil advisors addressing the urgent transition towards climate resilient, biodiversity-based agriculture and forestry, as these sectors currently manage most soil and concentrate most soil advice supply and demand processes .

These challenges within this transition include the need to enhance sustainability, increase productivity, and adapt to a changing climate. Soil degradation, such as erosion, compaction, and nutrient depletion, poses a serious threat to agricultural productivity and ecosystem health . Additionally, the intensification of agricultural practices has led to the excessive use of chemical inputs, causing soil pollution and environmental concerns. In the forestry sector, issues like deforestation, unsustainable logging practices, and the loss of biodiversity have become pressing concerns.

This transition involves multiple changes at the field level, aiming to reintroduce complexity, heterogeneity, and restore connectivity and natural processes at the landscape scale, while ensuring compatibility with agricultural and forestry production. These transitions encompass various aspects:

- Shifting from irrigated to rainfed agriculture.
- Transitioning from arable agriculture to grassland.
- Moving from single-species grasslands to diverse herbal leys.
- Transforming drained fields to support paludiculture.
- Shifting away from crop and tree monocultures towards agroforestry and silvopasture landscapes.
- Transitioning from intensive animal farming to grazing practices across landscapes.

The challenges associated with these transitions include reducing dependence on synthetic inputs and soy-based processed feed, ensuring good working conditions for all individuals involved in the farming and forestry sectors, attracting new entrants to these fields, and providing affordable, healthy, sustainable, and climate-friendly diets for all Europeans.

To effectively address the challenges, it is necessary to upskill existing advisors, attract new professionals with diverse profiles, and establish innovative business models.

Furthermore, the next generation of soil advisors must also develop soil advice practices that are suitable for tackling soil health issues in urban and industrial areas. While the main activities in these sectors are not directly linked to soil health, preserving and restoring soil health in urban and industrial areas, such as reversing soil sealing and remediating soil pollution, is crucial. These actions, especially when implemented through multifunctional blue-green infrastructure, can play a



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significant role in mitigating climate extremes and reducing the risk of natural disasters. Additionally, addressing soil health and restoring ecosystems in urban and industrial landscapes, which were previously agricultural and forestry land, can provide much-needed connectivity across landscapes.

It is worth noting that many urban and industrial landscapes in Europe have been constructed on former agricultural and forestry land. Addressing soil health and restoring ecosystems in these areas can provide much-needed connectivity across landscapes.

2. Unlocking the potential of Nature Based Solutions for Soil advice.

NBSOIL (Nature Based Solutions for Soil Management) is a four-year project coordinated by the Institute of Soil Science and Plant Cultivation IUNG-PIB (PL) which aims to co create and test a learning pathway for existing and aspiring soil advisors.

Soil advisors are key actors for the success of the Soil Health Living Labs and the Soil Mission. As NBSOIL is the only currently funded Soil Mission project³ directly addressing soil advice and soil advisors, research activities are focused on how available knowledge can be made available to land managers across different sectors through soil advice processes fully aligned with the Soil Mission's timeframe and objectives, together with the wider EU and global targets, such as the ones described in the EU Water Directive, the forthcoming Soil Health and Nature Restoration Law, the EU Farm to Fork and Biodiversity Strategies, and the Sustainable Development goals.

NBSOIL focuses on Nature Based Solutions (NbS) In order to adequately and simultaneously address the societal, environmental and economic dimensions of soil health. The aim is both to develop NbS for soil health and to unlock the potential of preserving and restoring soil health as a NbS to address multiple other challenges.

The International Union for the Conservation of Nature (IUCN) defines NbS as actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits⁴. Nature-based solutions are actions to protect, sustainably manage and restore natural and

³ https://rea.ec.europa.eu/news/eu-mission-soil-deal-europe-ten-new-projects-prepare-ground-transition-towards-healthy-soils-2030-2022-12-05_en

⁴ IUCN (2020). Global Standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of NbS. First edition. Gland, Switzerland: IUCN.



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modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature. Following IUCN's definition, NBS address societal challenges through the protection, sustainable management and restoration of both natural and modified ecosystems, benefiting both biodiversity and human well-being.

The concepts that inspire and underpin NBSOIL are best found within Agroecology, a holistic approach that “simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems. It seeks to optimise the interactions between plants, animals, humans and the environment while taking into consideration the social aspects that need to be addressed for a sustainable and fair food system.” (FAO, 2018).

The IUCN Global Standard provides clear parameters for defining NBS and a common framework to help benchmark progress. This framework is essential to increase the scale and impact of the NBSOIL approach, while it also helps in preventing unanticipated negative outcomes or misuse during the design phase, and will be used to assess the effectiveness of interventions.

3. Developing the NBSOIL Theory of Change

NBSOIL overarching methodology is Theory of Change (ToC)⁵, a methodology which has extensively been used in agricultural development and cooperation research programs, notably the ones from CGIAR (formerly Consultative Group on International Agricultural Research). Theory of Change is “a comprehensive description and illustration of how and why a desired change is expected to happen in a particular context”⁶. An interesting example is the Soil Health Theory of Change developed by the Global Collaboration for Resilient Food Systems (CRFS), a program of the McKnight Foundation that has funded agricultural research since the 1980s⁷

The NBSOIL ToC will support the development of the project towards the achievement of the specific objectives and deliver the expected outcomes and impacts, by defining the Impact Pathways that will be described in the Impact Section. It will also provide a framework that is flexible enough to integrate partners' previous experience, all the methodological elements and

⁵ Mayne J, Johnson N. Using theories of change in the CGIAR Research Program on Agriculture for Nutrition and Health. *Evaluation*. 2015;21(4):407-428. doi:10.1177/1356389015605198

⁶ <https://www.theoryofchange.org/what-is-theory-of-change/>

⁷ <https://www.ccrp.org/resources/soil-health-theory-of-change/>



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specific methodologies needed to address the different dimensions of an ambitious, multi actor project

This initial version is built on the concepts and Impact Pathways already defined at the proposal preparation stage and now included in the Grant Agreement.

The aim is to create a clear and concise document and use it to foster debate at several levels: within the NBSOIL consortium, with the other Soil Mission projects, with stakeholders, notably the ones involved in the training co -creation process, and with policy makers. To this end it will be made available as a Living Document and specific activities to gather and define contributions and update the following versions will be organised, in a process mirroring and mutually support the co - creation of the NBSOIL Academy and other project results, and in line with the Multi - Actor, participatory approach inspiring NBSOIL and the future Soil Health Living Labs.

3. Main elements of the NBSOIL ToC

SPECIFIC NEEDS	MAIN ASSUMPTIONS	IMPACT PATHWAYS	OUTCOMES
Need to transition to low-input, climate adapted soil management systems.	Understanding and functionally mimicking natural soil processes in managed ecosystems is the key to preserving and recovering soil health.	IP1. Mainstream Nature Based Solutions knowledge and advice for soil management.	Train 300 Soil Advisors across all partner countries (ALL IPs) 50 projects start to be developed through the Collaborative platform - marketplace (ALL IPs)
	Co-creating knowledge, tools, products and marketing strategies with stakeholders will ensure that relevant communities are	IP2. Provide Soil Health Living Labs facilitators	Cover crop as a NBS for soil fertility and nutrient manage advice included in the FaST tool and



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<p>Need to integrate currently fragmented knowledge collaborate among soil advisors and connect with land managers</p> <p>Need for flexible and attractive modes of training advisors, giving and receiving advice.</p>	<p>engaged and that results are relevant to society.</p>		<p>adopted by 10.000 farmers (IP2)</p> <p>20 Soil Health Mission Living Labs initiated by NBSOIL Academy first generation of participants (IP2)</p>
	<p>Inclusive, user friendly, assessment and mapping digital tools will enable a better knowledge of agroecosystems.</p>	<p>IP3. Make soil monitoring and mapping tech user friendly and inclusive</p>	<p>Local and regional authorities in 7 European cities receiving advice as part of practice - final projects. (IP4)</p>
	<p>Empowerment, equality and increased cooperation among value chain actors is essential to sustainability.</p>	<p>IP4. Embed soil care across all land management and land related decision making processes</p>	

3. Impact Pathways and first steps

IP1. Mainstream Nature Based Solutions knowledge and advice for soil management.

This Scientific, Societal and Economical/Technological Impact Pathway departs from the NBSOIL scientific results included in the Knowledge base (D1.1) and the Soil and NBS handbook (D2.3), as well as the Organic soil management as a reference (D1.3). These results are shared from early stages and widely discussed, quoted, and shared, inspiring from students and early career researchers to senior scientists. The Knowledge base (D1.1) grows quickly in users and contributors and inspires other researchers to design complex experiments testing NBS and managing multiple ecological interactions. This leads to an increased use of ARIES Open Source modelling which allows to integrate independently produced data and models through semantics. This eventually promotes interdisciplinary collaboration among scientists and increased adoption of holistic approaches to soil related research. Agroecology and Nature Based Solutions increase their importance in research activities and programs at national and EU level, and eventually are



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seen as essential to solve the challenges of recovering biodiversity while mitigating climate change, adapting to current and future climate change and providing affordable, healthy and nutritious food.

Shortly after the project ends, NBS solutions are mainstreamed into soil advice and management through upskilling and capacity building amongst soil advisors participating in the NBSOIL Academy training and subsequent editions and adaptations, increasing their employment opportunities and boosting green jobs. The NBS categories researched in depth in NBSOIL demonstrate their multifunctionality and potential to address the Soil Mission objectives and the Soil and NBS handbook is widely disseminated:

Inclusion of **cover crops** in cropping rotations supports the recovery of above and below ground biodiversity, increases SOC and reduces dependency on synthetic inputs. Organic soils are allowed to recover natural water levels, as **paludiculture** techniques make their restoration compatible for grazing by adapted breeds. **Forest management aiming for diversification in age and species** leads to a reduction in erosion, the risk of fires and landslides, together with promoting cooperation throughout the watershed to improve water quality and reduce the risk of flooding during heavy rains. **Bioremediation** techniques based on phytoextraction complemented with bacterial and fungal remediation allow to safely use polluted lands, and in some cases to extract useful metals such as copper. Urban planning practices integrate soil quality evaluation procedures. Local experts and community organisers rely on the outputs of the soil evaluation to engage local communities in participative design processes to identify and co - design specific **Blue green infrastructure**, enabling climate adaptation and prevention of floods. Finally, a significant amount of **organic fertilisers** are locally produced by valorising agricultural, livestock, forestry and urban waste, further reducing dependency on synthetic fertilisers and preventing water pollution from livestock slurry.

IP1 First Steps (M6):

Understanding NBS in relationship to ecological succession theory and in the context of different approaches

Arable agriculture, commercial tree plantation management and “gray” infrastructure often unintentionally mimic early ecological successional stages (bare agricultural or forest soil, bare concrete pavement) .



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When designing and implementing NBS, functions previously provided by synthetic inputs or artificial structures are replaced by ecosystem services in a manner that align environmental, social (health) and economic benefits. In this sense, NBS and related approaches might be seen as a way to reintroduce complexity and advance ecological succession in human managed ecosystems. NBS can be then seen in perspective with other approaches, which can be compared **according to how much have natural processes been replaced by artificial/human made systems.**

Scale of systems according to how much have natural processes been replaced by artificial/human made systems					
Completely artificial	Controlled environment	NBS Agroecology Permaculture Regenerative agriculture	Rewilding	Strict nature preserve	Wilderness
Artificial lawn over pavement	High input, high maintenance grass monoculture (golf fields in S. Spain)	Cover crops Herbal leys and rotational grazing, seasonal grazing by transhumant herds	Wild or semi wild herbivore reintroduction	Closed off to the public.	Not managed, not disturbed.
Channeled and covered river	Riverbed dammed, channeled but not covered	River renaturalised, riverwalk included (Blue - green infrastructure)	Beaver reintroduction	Closed off to the public.	Not managed, not disturbed.



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	Tree plantation monoculture from greenhouse raise saplings				
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Defining when promising management practices and approaches are actually NbS according to IUCN global standard.

NBSOIL will focus on 6 multifunctional NBS categories to develop a holistic approach to land management and soil health fully in line with the IUCN Global Standard for NBS (IUCN, 2020)⁸: organic fertilisers from locally available biowastes, cover crops, paludiculture, forest diversification, bioremediation, and blue - green infrastructure in urban and periurban areas. These categories will support soil advisory capacities for agriculture, forestry, urban planning, and restoration of industrial sites. Emphasis will be made on the connection between different ecosystems and settings, and the integration of solutions in circular strategies

IUCN will review this NBS categories and assess the use of selected practices through the IUCN Global Standard for Nature Based Solutions (NBS), providing recommendations to better integrate those interventions within the NBS framework, with special attention to identification of synergies and trade offs, and mitigation for negative side effects.

The IUCN Global Standard provides clear parameters for defining NBS and a common framework to help benchmark progress. This framework is essential to increase the scale and impact of the NBSOIL approach, while it also helps in preventing unanticipated negative outcomes or misuse during the design phase, and will be used to assess the effectiveness of interventions.

The Global Standard includes an assessment tool that consists of eight criteria and associated indicators, which address the pillars of sustainable development (economy, environment and society) and resilient project management. The output of this assessment comes in the form of a percentage match compared against good practices, with a traffic light system to identify areas for further work and adherence to the IUCN Global Standard.

⁸ IUCN (2020). Global Standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of NbS. First edition. Gland, Switzerland: IUCN. ISBN: 978-2-8317-2058-6 DOI: <https://doi.org/10.2305/IUCN.CH.2020.08.en>



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IP2. Provide Soil Health Living Labs facilitators:

This Scientific, Societal and Economical/Technological Impact Pathway departs from the development of the NBSOIL Academy, including the Introductory MOOC (D3.2) and the Advanced training: 1. Soil and NBS, 2. Soil Health, 3. Digital tools for soil health monitoring and mapping, 4. Improving soil related decision making in business and policy (D3.3). The MOOC serves to increase interest in Soil Health. The advanced modules are created through a participative process, taking into account existing learning materials and programs, mapping the soil advice ecosystem in the EU, contributing to integrate previously fragmented knowledge, and creating channels for communication and collaboration across EU countries and regions. Through their participation in the NBSOIL academy, existing soil advisors become more confident with Open Innovation processes. Getting acquainted with existing LL during the second half of the training, by the end of the project the 300 training participants are empowered to lead and participate in the Soil Mission Living Labs and to efficiently support existing and aspiring Soil Lighthouse farms, while soil literacy and awareness of soil related NBS is raised among community leaders and organisers in a cross-pollination process of skills.

IP2 First Steps (M6):

Soil Health Living Labs and lighthouses are essential elements of the Soil Mission, as its main aim is to create “100 living labs and lighthouses to lead the transition towards healthy soils by 2030”⁹

NBSOIL and all the other current Soil Mission projects are looking forward to the first Soil Health Living Labs (SHLL) being established. The first call addressing SHLL will close on the 20/09/2023. In the call description SHLL are described as.:

“(…) collaborations between multiple partners that operate and undertake experiments on several sites at regional or sub-regional level. Individual sites could be e.g. farms, forest stands, urban green or industrial areas, enterprises and other entities, where the work is carried-out and monitored under real-life conditions, regardless of the land size, tenure (land ownerships) or the type of economic activity.”¹⁰

⁹ https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/soil-health-and-food_en#:~:text=The%20main%20goal%20of%20the,foundation%20of%20our%20food%20systems.

¹⁰ <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-miss-2023-soil-01-08;callCode=null;freeTextSearchKeyword=Living%20Labs;matchWholeText=true;typeCodes=0,1,2,8;statusCodes=31094501,31094502;programmePeriod=null;programCcm2Id=null;programDivisionCode=null;focusAreaCode=null;destinationGroup=null;missionGroup=null;geographicalZonesCode=null;programmeDivisionPr>



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Several initiatives with the potential to become Soil HEalth Livign Labs and Lighthouses have already been identified by PREPSOIL in an interactive map¹¹.

We consider that current and future Soil Health Living Labs can find an useful reference in the Field Labs developed by Innovative Farmers, a partnership for interactive innovation in agriculture coordinated by the Soil Association:

Field Labs are practical, farmer-led trials carried out on-farm relying on enhanced farmer-researcher collaboration in order to develop and test management practices and develop appropriate technology.

These trials address a wide range of sustainability and resilience challenges in farm businesses. Examples of current field labs include tomato sensors, potato pests, and agroforestry on livestock farms.

Over the past decade, Innovative Farmers has successfully launched more than 120 field labs and provided over £450,000 in grants to farmer groups, empowering them to research topics relevant to their needs. The concept of field labs, initially unfamiliar, has now become firmly established in the mainstream. These trials have not only increased farmers' confidence in on-farm experimentation and innovation but have also fostered collaboration between farmers and the research community. The farming industry as a whole now recognizes the value and significance of on-farm trials, resulting in a growing culture of sharing and knowledge exchange.

NBSOIL will rely on the Field Labs methodology and experience¹¹ to train soil advisors in interactive innovation facilitation, we also expect to collaborate with the NATI00Ns projects and identify ways to transmit the Field Labs experience to the future SHLLs.

IP3. Make soil monitoring and mapping tech user friendly and inclusive:

This Societal and Economical/technological Impact will depart from the NBSOIL Soil Health assessment, monitoring and mapping resources, including the Sampling and testing protocols for soil health and biodiversity (D1.2) Soil Health Index - online tool and user's guide (D2.1) together with Soil Sensing handbook: satellite, UAV images and ground sensing (D4.1). Capacity building and upskilling of soil advisors with appropriate tools will support wider adoption by all users and

aspect=null;startDateLte=null;startDateGte=null;crossCuttingPriorityCode=null;cpvCode=null;performanceOf Delivery=null;sortQuery=sortStatus;orderBy=asc;onlyTenders=false;topicListKey=topicSearchTablePageState

¹¹ <https://prepsoil.eu/living-labs-and-lighthouses/map>



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mainstream the adoption of the most effective tools as tested in NBS field sites, living labs and lighthouse farms engaged in the training activities. The NBSOIL GIS Tool (D4.2) is linked to the EU FaST platform and together quickly gains users, contributing to mainstreaming appropriate soil monitoring and mapping tech and support for a wide range of land managers. Satellite images and COPERNICUS services are more widely used for soil advice, agricultural and forestry planning, together with EU Soil Observatory The NBS Smartphone use for Soil Citizen Science guidelines (D4.3) will contribute to strengthen Citizen Soil Science and leverage smartphone use. Notably, communities of developers and users of Open Source soil monitoring and mapping apps grow, leading to the development of advanced, commercial applications.

By the end of the project, a high number of farmers and farm advisors are better acquainted with offering advisory services and collaborating online in the NBSOIL Marketplace - Collaborative platform (D6.4), including the interpretation of soil data and elaboration of soil maps, and the design and management of transnational projects. Avenues for collaboration on soil health related projects between advisors, researchers, communities, local authorities, businesses and policy makers are identified and resources developed to build trust, effective communication and joint action.

IP3 First Steps (M6):

The first steps within this Impact Pathway are related to the design of the NBSOIL GIS tools and the possibility of coordinating efforts with other Soil Mission projects like AI4SOILHEALTH which expect to develop similar digital tools for Soil Health.

NBSOIL GIS tool - functionalities from a user's POV

NBS	Organic Fertilisers from locally available biowastes	Cover crops	Forest diversification in age and species
Initial, specific data - user provided.	Map locally available biowastes and show their availability, quality, quantity, prices.	Show fields and crops, crop rotation. Climate and type of soil.	Count the trees in a given area and Identify species. Track age and notes on pests, problems, etc.



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Overlap with existing data and models	Fertiliser use and nitrate pollution?	Erosion risk Soil organic carbon	Identify sensitive spots for soil erosion. Fire risk Flood risk
What to extract - calculate. Support for planning and decision making.	From a given area, calculate potential compost mixtures, price. Time for composting according to local temperatures?	Recommend cover crop (seed mixture) depending on water availability, temps, time between main crops, specific problems (weed suppression, plough sole breaking, etc)	Identify suitable flat spots for clearing. Recommend species
How to validate	Composting process. Compost quality. Monitor use on fields, effects on crops and soil vs. chemical fert?	monitor cover crop: data on seeds, date of emergence, level of covering, etc. Track results on crop production and soil health.	Monitor diversification effects on modelled fire and flood risk (validate?). Soil health. Biodiversity.
NBS	Paludiculture	Bioremediation	Blue - green infrastructure
Initial, specific data - user provided.	Map rewetted plots and the ones which could potentially be rewetted. Indicate level of degradation (from peat extraction, drying, etc).	Map polluted areas and levels of pollutants identified. (sample grid).	Map existing and potential blue green areas.
Overlap with existing models and data	Estimate GHG emissions reduction from rewetting. Estimate water storage - buffer against drought, fire risk reduction,	Asses risks of leaching, bioaccumulation, etc.	Overlap with population, heat maps, pollution, darinage/sealed soil/flooding hotspots.




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What to extract - calculate. Support for planning and decision making.	Recommend uses. Potential production, cost/benefit, carbon credits, etc.	Bioremediation solution and time needed. Potential uses for the area in the meanwhile according to safety (from close area to compatible with a green area)	Show shade provided, reduction of soil sealing, water storage, thermal effects (soil and air temperature reduction during hot periods).
How to validate	Monitor biodiversity recovery, uses and production.		Monitor temp reduction. Monitor species and biodiversity. Monitor use by people

IP4. Embed soil care across all land management and land related decision making processes:

This Societal and Economical/technological Impact departs from the results gathered in the results pack NBSOIL Policy Navigator (D5.3) Making existing Soil Health related policies and regulations (D5.3.1) in NBSOIL countries (PL, AT, CH, UK, NL, FR, ES, IT) more accessible will provide a wide diversity of examples, from the EU and beyond. It is expected to diminish barriers for Soil Advisors to collaborate in complex projects involving more than one country or region. This information will be highly valuable to researchers engaging in policy analysis. This database and navigator is expected to be further developed, encompassing other countries and involving higher details regarding regional and local regulations. On the other hand, the policy briefs will deliver recommendations for the mid term Soil Mission, FtF, EU Biodiv. Strategy and CAP evaluations (D5.3.2), informing about soil NBS and blended, participative training of soil advisor for collaboration and soil health related innovation, and how these emerging soil advisors can support the aforementioned strategies in their final phase, while recommending changes for a better alignment between environmental, social and economic goals.



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In this line, the recommendations addressing the post 2027 CAP will deliver a vision based on the shift from a fossil fuel and synthetic inputs based agriculture towards climate smart, biodiversity based, information and collaboration intensive farming modes.

Thanks to the D5.4 Spatial planning and soil NBS toolkit (D5.4) the soil advisors, directly or in the frame of the Soil Health Living Labs and Lighthouses developed as the Soil Mission progresses, will demonstrate best practice soil care to land managers and decision makers alongside the upskilling of their advisors to provide a consistent message on the benefits of these approaches. Joint action from society actors to develop business models to support best practice soil care will also aid effective embedding.

IP4 First Steps (M6):

By collaborating among themselves, with researchers and other professionals and stakeholders, the new generation of Soil Advisor should be capable of providing advice that is:

1. Context based and scale sensitive, work across sectors and take into account wider context.
2. Aware of global challenges and policy frameworks.
3. Appropriate level of technology for each user.
4. Take into account the challenges of mitigating GHG, adapting to climate change, and reverting biodiversity collapse, and notably phasing out synthetic inputs, restoring ecosystems including agroecosystem by introducing higher levels of complexity and heterogeneity and sunstitiung gray infrastructure.
5. Engage both current soil advisors and new entrants to soil advisory and to agriculture, and
6. Address new sectors and establish soil related solutions

The challenge is how to build trust and efficient communication channels and workflows. Collaboration is also needed among land managers and owners so they can implement comprehensive soil health approaches.

4. Expected outcomes defined by the topic and quantified indicators:



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Project activities are expected to contribute to all of the following outcomes described in the topic text:	Examples of how NBSOIL Impact Pathways will contribute towards expected outcomes by project's end (2025 - 2026) and following year (2027)
<p>EO1. advisory services are strengthened in their knowledge and skill base to provide impartial advice on soils and their sustainable management, based on a thorough understanding of soil functions and ecosystems services supported by soils across land uses and climate zones throughout Europe;</p>	<p>Train 300 Soil Advisors across all partner countries (ALL IPs)</p> <p>Make available a Knowledge base with 60 specific examples of the 6 NBS categories researched (IP1)</p> <p>Modelling resources to understand soil functions (ARIES) (IP1, IP2)</p>
<p>EO2. new forms of advice are tested and established, making more effective use of digitization and new models for advisor-farmer-data interactions; land managers (including owners leasing their land) and other practitioners in rural and urban areas (e.g. farmers, foresters, local authorities in charge of managing green spaces and natural areas) have increased opportunities for access to tailored, practice-oriented knowledge and for exchange of experiences on how to manage land and soils in more sustainable ways;</p>	<p>Participants complete 50 practical exercises blending remote and in - person sessions (IP1, IP2)</p> <p>30 farms and 10 forestry plots in the project's countries are supported to become Soil Mission Lighthouses (IP2)</p> <p>Mapping and advice for spatial planning integrating blue - green infrastructure in 7 European cities (IP4, IP3)</p> <p>Input gathered from 500 citizens using citizen science apps for simple smartphones (IP3)</p> <p>50 projects start to be developed through the Collaborative platform - marketplace (ALL IPs)</p>
<p>EO3. the farming sector is better equipped to contribute to meeting targets from the Farm to Fork Strategy[1] [2] and the new EU Soil Strategy[3], in particular with regard to the management of nutrients;</p>	<p>40 new pilot plants producing organic fertilisers form available biowastes set up (IP1)</p> <p>Cover crop as a NBS for soil fertility and nutrient manage advice included in the FaST tool and adopted by 10.000 farmers (IP2)</p>
<p>EO4. more interactive and effective agricultural and forestry knowledge and innovation systems are in place;</p>	<p>20 Soil Health Mission Living Labs initiated by NBSOIL Academy first generation of participants (IP2)</p> <p>Updated and improved NBSOIL Academy 2.0 launched involving 1000 participants and new 5 countries, including Greece, Denmark and Romania (ALL IPs)</p>
<p>EO5. local/regional authorities are in a position to integrate considerations on soil health (e.g. reuse of soils, reduction of soil sealing, management and increase</p>	<p>Local and regional authorities in 7 European cities receiving advice as part of practice - final projects. (IP4)</p> <p>20 innovative Blue - Green infrastructures designed and</p>



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of green spaces in urban areas) into spatial planning and decision-making.	implemented together with stakeholders. (IP4, IP1)) NBSOIL Spatial Planning toolkit adapted by 10 rural municipalities for their own use.(IP4, IP3)
Mission Impacts (longer term: 2032 - 2040)	
MI1. “Soil literacy” , awareness and societal appreciation of the vital functions of soils are significantly increased and result in wide societal engagement on soil health.	The NBSOIL learning materials are adapted for use in secondary education in the project countries. (IP1) Updated and improved versions of the MOOC are launched every year, engaging approx. 10.000 participants per year. (IP1)
MI2. The links between healthy soils, nutritious and safe food and a healthy environment are better understood.	The NBSOIL Knowledge Base in its further editions grows to 10.000 articles (IP1) of which approx. 20% refer to the links between a healthy environment, healthy soils and nutritious and safe food.
MI3. Land managers ^[2] , industries, consumers and society at large work together and take effective action on soil health across sectors and land uses, as informed by best available science, thereby significantly alleviating not only the immediate pressure on soils but also on the surrounding environment including water bodies.	NBSOIL Academy provides facilitators ready to coordinate and contribute to other 5000 Soil Health Living Labs, coordinate 1000 Regional clusters and 10 large scale transnational watershed projects, notably addressing the Danube basin. (IP2)
MI4. Robust soil monitoring programmes and common definitions are in place (based on common, harmonised and comprehensive measurements) and allow land managers and public authorities to take effective actions based on up-to-date information from all Member States and Associated Countries.	100.000 million EU citizens are actively involved in Soil Monitoring through smartphone apps relying on the NBSOIL Soil Health index and guidelines for citizen science. (IP3) NBSOIL Spatial Planning toolkit adapted by 10 EU capitals and other 100 cities and 1000 rural municipalities for their own use.(IP4, IP3)

MI5. The successful implementation of the mission supports several EU policy and international commitments, e.g. in relation to land degradation neutrality, food and nutrition security, climate and biodiversity	organic fertilisers from locally available biowaste	cover crops	paludiculture	forest diversification	bioremediation	Blue - green infrastructure
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SDGs, (GENERAL; IPS)	SDG4"Quality Education"; SDG15"Life On Land"; SDG8 "Decent Work and Economic ; SDG13"Climate Action"; SDG6 "Clean Water and Sanitation"; SDG2"Zero Hunger"; SDG5 "Gender Equality" Growth"; SDG 10 "Reducing Inequality" and SDG 11 "Sustainable Cities and Communities"					
Climate Action (UNCCD)	x	x	x			x
Biodiversity (UN CBD)		x	x	x		x
Green Deal including the Farm to Fork Strategy, Biodiversity Strategy	x	x	x	x		
New Soil Strategy	ALL, notably cover crops and forest diversification					
Zero Pollution Strategy,		x			x	
Forestry Strategy or the				x		
Long-term Vision for Rural Areas) (GENERAL , IPS)	Potentially ALL when aligned with entrepreneurship and creation of good quality employment in the bio economy and ecological restoration					



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