



D4.1 Report on LL/LH taxonomy, identification and mapping feeding the online interactive atlas

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Executive Summary

The Mission “A Soil Deal for Europe” aims to establish 100 Living Labs and Lighthouses to lead the transition towards healthy soils by 2030. In this context, criteria have been outlined in the Mission Soil Implementation Plan to define the aims, activities, participants, and context such Living Labs and Lighthouses need to align to in the context of the Mission Soil.

First project funded under the Mission Soil, PREPSOIL facilitates the deployment of the Mission across European regions, by helping key players to reduce soil degradation, while increasing soil awareness and soil literacy. In particular, Work Package 4 “Knowledge transfer and co-creation in regional living labs” lead by the European Network of Living Labs, focuses on improving the understanding of the concept of Living Labs and how they can lead to improvement of soil health, developing a new taxonomy, mapping current and emerging initiatives, and delivering a service package for Living Labs and Lighthouses including model business plans to support long-term stability of such initiatives.

In this context, this document (Deliverable 4.1) titled "Report on LL/LH Taxonomy, Identification, and Mapping Feeding the Online Interactive Atlas," introduces the **PREPSOIL Taxonomy** that further defines and complement the Mission Soil criteria for Living Labs and Lighthouses. Developed through literature review and co-creation activities within the PREPSOIL project and in collaboration with sister projects such as SOILL-Startup and NATI00NS, the PREPSOIL taxonomy supports the definition and categorization of soil health LL and LH initiatives along a structured approach. By categorizing LLs and LHs according to specific land use types – agriculture, forestry/natural, (peri-)urban, and (post-)industrial – the taxonomy enables a precise identification of unique characteristics, criteria, and requirements. Intended to identify the necessary elements of Living Labs and Lighthouses aligning to the Mission Soil criteria and objectives, the PREPSOIL taxonomy should not serve as a rigid, prescriptive set of rules but rather as a flexible guideline, adaptable to the unique requirements and conditions of each specific context.

Alongside, this deliverable presents the mapping exercise performed by PREPSOIL to identify all the European Living Lab and Lighthouse initiatives operating in the context of the Mission Soil to feed an interactive atlas available on the PREPSOIL website¹.

While the mapping work performed and presented in the document does not assess the alignment of the mapped initiatives to the Mission Soil criteria and PREPSOIL taxonomy, the deliverable also introduces the method to classify Living Labs and Lighthouses initiatives operating in the Mission soil context across a three-level scale:

1. **Mission Soil Living Labs and Lighthouses** funded under dedicated topics of the Mission Soil.
2. **European Soil Living Labs and Lighthouses** that are aligned to the Mission Soil criteria and PREPSOIL taxonomy but do not receive direct funding from the dedicated Mission Soil topics.
3. **Emerging Soil Living Labs and Lighthouses** that exist within the broader European landscape that have not yet fully aligned with the Mission Soil criteria and PREPSOIL taxonomy.

¹ <https://prepsoil.eu/living-labs-and-lighthouses/map>



Finally, this deliverable presents also the PREPSOIL self-assessment tool, designed in alignment with the PREPSOIL taxonomy to support the classification of the mapped initiatives, distinguishing them along the three-level scale. While allowing such classification, the tool will also facilitate self-reflection and monitoring for learning of the different initiatives, while supporting the identification of needs of European initiatives for new and improved support services to be delivered in the whole Mission Soil context to enhance the growth and impact of Living Labs and Lighthouses.

Looking forward, it is crucial that Living Labs and Lighthouse initiatives actively use the PREPSOIL taxonomy to adapt to their unique contexts and foster innovation. Regular progress mapping through the PREPSOIL self-assessment will support continuous improvement and alignment with Mission Soil objectives.

Additionally, it is recommended that different Mission Soil projects, including but not limited to PREPSOIL and SOILL-Startup, ensure that service packages, tools, knowledge and support materials align with the PREPSOIL taxonomy to address the mapped needs of Living Labs and Lighthouses.



List of abbreviations & acronyms

CAP	Common Agricultural Policy
D	Deliverable
EC	European Commission
ENoLL	European Network of Living Labs
EPA	Environmental Protection Agency
ES	Experimental Site
EU	European Union
FPA	Framework Partnership Agreement
GA	Grant Agreement
GDPR	General Data Protection Regulation
GIS	Geographic Information System
ICT	Information and Communications Technology
KPIs	Key Performance Indicators
LHs	Lighthouses
LLs	Living Labs
MS	Milestone
MRV	Measurement, Reporting, and Verification
N/A	Not Assessed
NBS	Nature-based Solutions
NCPs	National Contact Points
NGOs	Non-Governmental Organizations
NIR	Near-Infrared
R&I	Research & Innovation
RI	Research Infrastructures
SHLHs	Soil Health Lighthouses
SHLLs	Soil Health Living Labs
SMEs	Small and Medium-sized Enterprises
SMS	Soil Mission Support
T	Task
WADIs	Water Drainage Infiltration
WP	Work Package
WWF	World Wildlife Fund



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1. Introduction

1.1 Context

The Mission “A Soil Deal for Europe”

Horizon Europe is the European Union’s (EU) framework programme for research and innovation for 2021-2027. Within the programme, five Missions provide actions designed to achieve bold, inspirational, and measurable goals within a specific timeframe over five major challenges identified as the greatest of our times, including: Climate Change, Cancer, Oceans and waters, Climate-Neutral and Smart Cities, and Soil (EU Missions in Horizon Europe, 2024).

The Mission "A Soil Deal for Europe" – hereafter referred to as Mission Soil – aims to establish 100 Living Labs (LLs) and Lighthouses (LHs) by 2030, leading the transition toward healthy soils. Recognizing the vital role of soil in sustaining life on Earth, the mission underscores its significance in supporting food systems, clean water, biodiversity, and climate resilience. It emphasizes the need to address the lack of awareness among various stakeholders, such as land managers, industries, consumers, policy makers, and society, as a key driver of soil degradation, impacting its ability to provide essential ecosystem services (EU Mission, 2024). As for the research and innovation components of the mission, these are knowledge development, knowledge sharing and transfer, knowledge application, and knowledge harmonisation which directly support to the main objective of the Mission Soil. Furthermore, the Mission Soil has eight specific objectives:

1. Reduce desertification,
2. Conserve soil organic carbon stocks,
3. Stop soil sealing and increase re-use of urban soils,
4. Reduce soil pollution and enhance restoration,
5. Prevent erosion,
6. Improve soil structure to enhance soil biodiversity,
7. Reduce the EU global footprint on soils, and
8. Improve soil literacy in society.

The Implementation Plan of the Mission Soil (European Commission, 2024) provides a clear definition of such initiatives for the purpose of the Mission:

- **Living Labs (LLs)** are defined as “user-centred, place-based and transdisciplinary research and innovation ecosystems, which involve land managers, scientists and other relevant partners in systemic research and codesign, testing, monitoring and evaluation of solutions, in real-life settings, to improve their effectiveness for soil health and accelerate adoption. These Living Labs are collaborations between multiple partners that operate at regional or sub-regional level and coordinate experiments on several sites within a regional or sub-regional area (or working landscapes).”
- **Lighthouses (LHs)** are defined as “places for demonstration of solutions, training and communication that are exemplary in their performance in terms of soil health improvement. They are local sites (one farm, one forest exploitation, one industrial site, one urban city green area, etc.) that can be included in a living lab area or be situated outside a living lab area.”



PREPSOIL and Work Package 4

The Preparing for the "Soil Deal for Europe" Mission project (PREPSOIL, n.d.) – the first one funded under the Mission Soil – aims to facilitate the implementation of the Mission Soil across European regions. This involves the collaborative development and use of tools and platforms for interaction, knowledge-sharing, and co-learning (PREPSOIL, n.d.). Additionally, the project includes stocktaking and dialogue to understand how a regional assessment of soil needs, supported by standardized monitoring mechanisms, can be translated into actionable initiatives within Living Labs and exemplary projects that promote soil health (PREPSOIL, n.d.).

Work Package (WP) 4, led by the European Network of Living Labs (ENoLL), focuses on "Knowledge transfer and co-creation in regional Living Labs." According to the Grant Agreement (GA), the objectives of WP4 are:

- To improve the understanding of the concept of LLs and how LLs/LHs can lead to a significant improvement of soil health.
- To map current and emerging LLs and LHs using a new taxonomy and to engage LLs in development to co-design a spectrum of model business plans considering the high variability among LL and the taxonomy.
- To create a service package for knowledge transfer and co-creation for LLs/LHs, prioritizing specific soil needs

Among the different tasks included in WP4, Task (T) 4.1 focuses on the creation of a conceptual framework for valuing and enhancing the LLs/LHs co-creation process under T4.1 "Specification of the unique features of Living Labs and Lighthouses on soil" led by INRAE. Moreover T4.2, is dedicated to the "Identification and mapping of Living Labs and Lighthouses". Led by ENoLL, the goal was to identify and map both current and emerging LLs and LHs in an interactive virtual atlas², showcasing LLs and LHs – either fully compliant to the Mission Soil criteria as further defined by the PREPSOIL taxonomy, as well as early-stage initiatives – on the PREPSOIL webpage to support collaboration and knowledge sharing among similar initiatives throughout Europe.

1.2 A taxonomy for LLs and LHs in the Mission Soil

Objective and impact

The PREPSOIL deliverable (D) 4.1, titled "Report on LL/LH taxonomy, identification and mapping feeding the online interactive atlas", aims to develop a detailed classification system for LLs and LHs. This taxonomy categorizes initiatives based on specific land use types, such as agriculture, forestry, peri-urban, and post-industrial, and links these categories to soil health criteria.

By providing a structured framework that systematically categorizes and differentiates LLs and LHs across various land use types, the taxonomy and process presented in this deliverable facilitates the better understanding, comparison, and analysis. It ensures consistency in terminology and methodology, supporting the identification and classification of these types of LLs and LHs.

² PREPSOIL Interactive Atlas. <https://prepsoil.eu/living-labs-and-lighthouses/map>



Relation to PREPSOIL actions

This report integrates insights from different project tasks and related milestones (MS), primarily stemming from WP4 but with relevant inputs from and in alignment to other key activities of the PREPSOIL project.

In particular, the taxonomy is the result of the activities and outputs of the consecutive work performed in T4.1 and T4.2. At first, the process was initiated in T4.1 with the definition of a conceptual framework situating the role of Living Labs in the Mission Soil, delineating general and specific characteristics across four land-use types. This was further elaborated in T4.2 leading to the taxonomy further defining the Mission Soil criteria and the self-assessment report for the mapping and classification of current and emerging LLs and LHs contributing to the Mission Soil goals.

Two MS have marked the progressive work presented in this deliverable whose report are provided in attachment to this document in ANNEX 4. Related milestone reports. MS5 (achieved in January 2024) provides the preliminary “Guidelines for mapping LL/LHs”, while MS6 “Material and prototype for virtual LL/LH interactive maps ready” (achieved in April 2024) details the creation of the online map of current and emerging LLs and LHs under the Mission Soil context.

Building from the data transferred by the Soil Mission Support project ((SMS, n.d.), presented in Chapter 1.3 Relation to other initiatives and projects), the PREPSOIL online map of established and emerging LL and LH initiatives was developed in synergy with WP3 “PREPSOIL web portal, online community engagement and training”.

Additionally, outputs and findings from WP2 "Identification, Mapping, and Evaluation of EU Regional Soil Needs" support this deliverable. The goal of WP2 was to identify existing soil needs in various representative regions of Europe (considering pedo-climatic zones and land uses) and to provide a foundation for recommending priority actions for implementation in LLs and LHs. These assessments identify soil needs, requirements from socio-economic and geo-biophysical perspectives, and drivers of change across different land uses. The WP2 cases are stakeholder-based evaluations in the 20 regional soil needs assessment workshops³.

Structure

The deliverable is structured to systematically develop and present a taxonomy for LLs and LHs involved in soil health. Besides this introduction, the document includes four chapters:

- Chapter 2 details the methodology, outlining the creation process of the taxonomy and self-assessment form.
- Chapter 3 offers an overview of the taxonomy, including a visual representation and descriptions of categories and sub-categories for various land use types (e.g., agriculture, forestry, (peri-)urban, (post-)industrial).

³ PREPSOIL. Soil Needs Assessment. <https://prepsoil.eu/soil-by-region>



- Chapter 4 introduces the classification of LLs and LHs along with the self-assessment form, outlining its purpose, role as a tool for self-reflection, and usability.
- Chapter 5 concludes the deliverable with an outlook on future directions and summarizes key findings.

In addition, the following guidance and complementary documents are provided in attachment to this document:

- Annex 1 provides comprehensive guidelines for utilizing the taxonomy,
- Annex 2 presents the self-registration and self-assessment questionnaire,
- Annex 3 reports the criteria for LLs and LHs as defined in the Mission Soil Implementation Plan
- Annex 4 provides the reports delivered as verification of achievement of MS5 and 6.

1.3 Relation to other initiatives and projects

In addition to relation within the PREPSOIL project actions, this deliverable also synthesizes and incorporates findings and outcomes from prior initiatives under Mission Soil and other relevant projects, along with ongoing collaborations with sister projects closely linked to PREPSOIL. As such, this section outlines both preceding and forthcoming activities and projects that are interconnected with D4.1.

Previous initiatives and projects

In relation to other activities, this project aligns closely and draws information from several key initiatives and projects described in Table 1.

Table 1. Projects and initiatives related to D4.1

PROJECT or INITIATIVE	GA and TIME	DESCRIPTION
SCAR-AE - Standing Committee on Agricultural Research ⁴	GA: 101060553 2023-2024	A coordination and advisory body on European agricultural and bioeconomy research. Within this initiative several working groups worked on the identification of key elements of Agroecology transition, including characteristics of Agroecology Living Labs.
ALL-Ready – The European Agroecology Living Lab and Research Infrastructure Network ⁵	GA: 101000349 2020-2023	Aimed to establish a framework for a prospective European network of LLs and Research Infrastructures (RI) to facilitate the transition to agroecology across Europe. Recognizing agroecology's potential to enhance sustainability and resilience in farming systems, the project addressed contemporary challenges such as

⁴ SCAR-AE. <https://cordis.europa.eu/project/id/101060553>

⁵ ALL-Ready. <https://cordis.europa.eu/project/id/101000349>



		climate change, biodiversity loss, resource scarcity, and declining soil and water quality.
SMS - Soil Mission Support ⁶	GA: 101000258 2020-2022	Aimed to develop a set of Research and Innovation (R&I) activities leading to an effective framework for action in Europe and globally in the fields of soil health and land management through the identification of criteria for LLs and LHs. In this project the first steps were taken to map LLs & LHs and to characterize and set criteria and definitions for soil health LLs & LHs.
VITALISE - Virtual health And wellbeing Living Lab InfraStructurE ⁷	GA: 101007990 2021-2024	The goal is to support LLs by developing Information and Communication Technology (ICT) tools for shared access on similar devices and applications. It will also create a harmonisation body to proceed towards the harmonisation of procedures of health and well-being LLs. By opening up LL infrastructures, the project will help to promote research activities in the health and well-being domain in Europe and beyond.
WATER MINING - Next generation water-smart management systems: large scale demonstrations for a circular economy and society ⁸	GA: 869474 2020-2024	Demonstrates and validates innovative water resource solutions on a pre-commercial scale, in line with EU regulations such as the Water Framework Directive, Circular Economy principles, and the EU Green Deal. It combines water management services with improving renewable resources like mining water to create value-added products that bolster regional resource availability and promote economic growth.

Sister Mission Soil projects

In line with the principle at the core of all EU Missions calling projects to operate as a portfolio of actions, PREPSOIL operates in alignment with other projects funded under the Mission Soil. Two of these are particularly relevant for the work implemented in WP4 and for the delivery of the PREPSOIL taxonomy: NATI00NS and SOILL/SOILL-Startup.

NATI00NS

The NATI00NS project (“National engagement activities to support the launch of the Mission ‘A Soil Deal for Europe’ 100 Living Labs and Lighthouses”, GA: 101090738,(NATI00NS, n.d.)) aims to facilitate the deployment of the EU Soil Mission across EU Member States and Associated Countries during most of its first ‘induction and pilot’ phase (2021-2025). The project has reported several capacity building

⁶ SMS. <https://cordis.europa.eu/project/id/101000258>

⁷ VITALISE. <https://cordis.europa.eu/project/id/101007990>

⁸ WATER MINING. <https://cordis.europa.eu/project/id/869474>



materials on different LLs/LHs and Soil Health-related topics aimed for the use of stakeholders as potential applicants to the Horizon Europe Topic Calls. Such materials are thus, used as base for the creation of this taxonomy. More specifically, the taxonomy gathers inputs from the five NATIONS factsheets which offer clear and concise information on the concept of LLs and LHs, as well as their specific role within the Soil Mission. The factsheets, titled "Funding Opportunities," provides an overview of the various types of LLs, the criteria for identifying Lighthouses, and the actions taken to support the development of LLs across Europe (Couture & Cavallo, 2024). The remaining four focus on each type of Living Lab that will receive funding, categorised according to their specific land use. These categories include agricultural, forestry, (post)industrial, and urban LLs. By delving into the unique characteristics and objectives of each type, the factsheets provide valuable insights for stakeholders in their respective fields. These factsheets were co-created and validated by soil health experts, some of which belong to the PREPSOIL project.

SOILL-Startup

The SOILL-Startup ("Startup of the SOILL support structure for SOIL Living Labs", GA: 101145592 (SOILL-Startup, n.d.)) is the first grant implementing the SOILL Framework Partnership Agreement ("Support Structure for Soil Living Labs", GA: 101112782, (SOILL, n.d.)) called to establish – in co-creation with the first two waves of Mission Soil Living Labs and Lighthouses – a one-stop-shop structure supporting the development, implementation and scale-up of these vital hubs.

Among the planned actions, a specific task of SOILL-Startup is dedicated to developing a harmonized assessment method and designing Key Performance Indicators (KPIs) for monitoring Soil LLs and LHs to enhance their impact and sustainability. This objective is divided into several phases: (i) mapping and categorisation of KPIs, (ii) validation of KPIs, (iii) framework design and assessment tools, and (iv) guidelines. The in-depth assessment tool will be primarily designed to monitor on a bi-annual basis the growth and progress of Mission Soil funded LLs and LHs, guiding the identification of areas needing further improvement and refinement.

To achieve this, a SOILL Pilot Working Group has been created to co-create and validate the outputs of this task. Alongside SOILL-Startup partners, the members of the group consist of experts in soil technical aspects and LL methodologies, Mission Soil secretariat and board members, as well as representatives from different Mission Soil projects including PREPSOIL.

The activities of SOILL-Startup run concurrently with the finalisation of PREPSOIL T4.2, with the final framework expected to be ready by July 2024. Consequently, inputs gathered from exercises conducted during the Pilot Working Group meetings have also informed the creation of the taxonomy central to this deliverable. Thus, this joint exercise where SOILL-Startup and PREPSOIL cooperate, are highly valuable for the creation of this taxonomy. The synthesized data resulting from the gathered inputs from the above-mentioned projects have been utilized in D4.1, allowing for the categorization of LLs/LHs in different land use types.



2. Methodological approach and co-creation steps

This chapter outlines the steps involved in the co-creation of the PREPSOIL taxonomy of soil health LLs and LHs and classification process. This approach has been developed by ENOLL and implemented along with the following T4.2 partners INRAE, WR, DELTARES, SLU, ÖMKi, AU, CSIC, NIBIO, ZALF, LESP IUNG, RE-SOIL, FUNDECYT-PCTEX, ACR+, COPA-COGECA, and JRC.

The co-creation cycle has been deployed over four macro-phases as depicted in Figure 1:

1. Understand
2. Co-design
3. Co-develop
4. Evaluate

These phases, further described below, are repeated twice following an iteration cycle to incrementally improve the proposed results over the project implementation. Such phases have been implemented through the consecutive implementation of T4.1 and T4.2, with the final validation extending beyond the PREPSOIL scope to the full Mission Soil implementation.

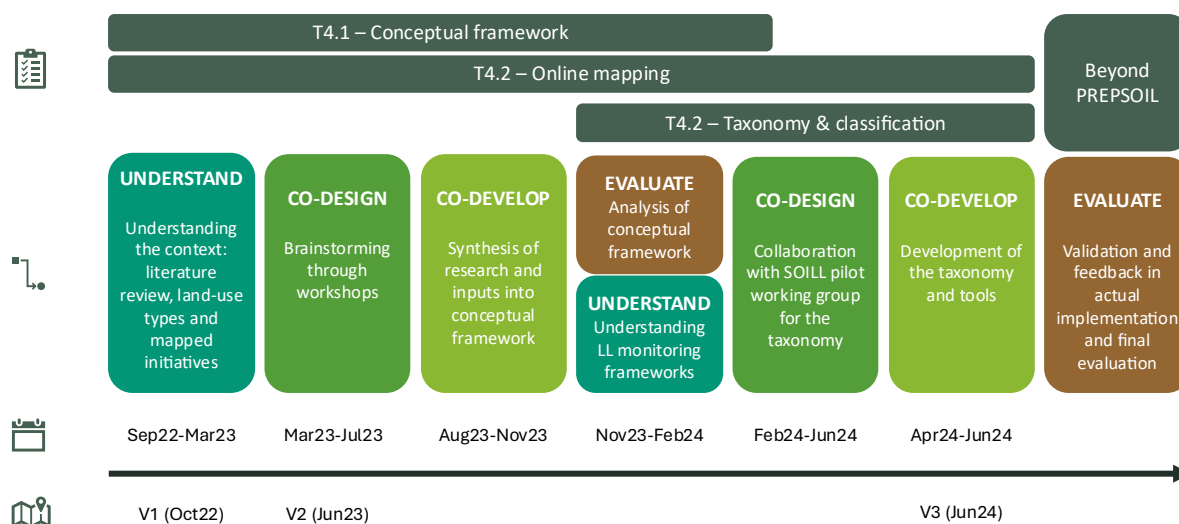


Figure 1. Methodological steps for the creation of the taxonomy and classification of Soil LLs and LHs.

Phase 1. Understand (T4.1 & T4.2, September 2022 - March 2023)

Conceptual framework (T4.1)

The initial phase involved a review focussed on gathering literature pertinent to the development of the conceptual framework for T4.1. The goal was to establish a theoretical foundation by exploring the context and characteristics of various land-use types essential for developing the framework titled "Conceptual framework situating the role of Living Labs in improving soil health" (presented in attachment to this deliverable, as a separate document, in ANNEX 5. Conceptual framework situating the role of living labs to improve soil health). Led by INRAE, this review involved studying literature collected specifically for this task with the objective to construct a conceptual framework informed by

existing knowledge, including insights from projects like ALL-READY, SMS, AE4EU⁹ and recent findings from ongoing European and Canadian LLs. Throughout this phase, the literature reviewed provided valuable insights into the role of LLs and LHs in enhancing soil health (Mambrini, 2022; Maring et al., 2022; McPhee et al., 2021). The review findings highlight the importance to integrate sustainability goals, diverse stakeholders, long-term innovation processes, and addressing implementation challenges (McPhee et al., 2021).

LLs and LHs initiatives mapping (T4.2)

In parallel, through an earlier than planned start of T4.2, PREPSOIL partners have proceeded to build the first version of the PREPSOIL map of potential Living Labs and Lighthouses across Europe building on the map developed by the SMS project that collected 241 initiatives (Figure 2).



Figure 2. Map of soil Living Lab and Lighthouses initiatives, SMS project, September 2021.

Alongside, the partners started analysis the SMS mapped initiatives to assess their alignment to the Mission Soil criteria. To support this process under the coordination of ENoLL with the support of Trust-IT, a centralised repository through an Excel database has been set up collecting each mapped initiative. For each of these, key information has been collected - such as descriptions, types (LL and/or LH), soil types, and contact information – ensuring that the collected details aligned with the map's overarching goals.

Alongside, in view of a cleaning process to ensure the high-quality of the map, T4.2 partners proceeded to a more detailed analysis of each initiative to identify if any of them were "not soil-related" (topics outside the scope of the Soil Mission) or "not active" (currently inactive initiatives). Alongside partners have further analysed the land-use types and soil needs mapped in WP2 to understand the differences between regions in Europe in terms of soil properties, land-use types, environmental zones, and socio-economic conditions for representation of the mapped initiatives.

⁹ AE4EU - Agroecology for Europe, GA: 101000478. <https://cordis.europa.eu/project/id/101000478/>



The first assessment process of SMS-mapped initiatives has resulted in the first version of the PREPSOIL map, published in October 2022, allowing users to select the initiatives by type (LL site, LHs or All), land use type (Agriculture, Forestry, Urban, Protected Areas, Industry, Infrastructure, or Other) and the funding category (EU Funded, All, or Others).

Phase 2. Co-design (T4.1 & T4.2, March-July 2023)

In this stage, the first co-design phase of the PREPSOIL taxonomy was collaboratively developed with task partners and, in specific cases, the entire project consortium. Three brainstorming sessions helped co-design the core concepts of the conceptual framework (T4.1) and improve the classification of LLs and LHs for an enhanced online map (T4.2), as detailed below.

Conceptual framework co-design (T4.1)

To develop the conceptual framework, a series of three workshops were organized between March and July 2023. These workshops aimed at integrating diverse knowledge based on partners' expertise in soil health and LLs to identify and define the characteristics of Soil LLs across different land-use types. Using a Miro visual board, partners discussed and collaborated, resulting in mind maps (see Figure 3) structured around the four criteria of the Mission Soil Implementation Plan (European Commission, 2024)(Aims, Activities, Participants and Context).

Such session helped define the features of LLs and LHs in soil health for each land-use type. In particular, T4.1 partners explored universal features common to all place-based LLs centred on soil health, as well as specific features for LLs dealing with natural areas, urban areas, and agroecosystems. The first two workshops were involved solely T4.1 partners assessing all key features. Due to limited input on industrial land-use type features, a third workshop was organised with all PREPSOIL partners, focusing solely on "Industrial soil health LLs".

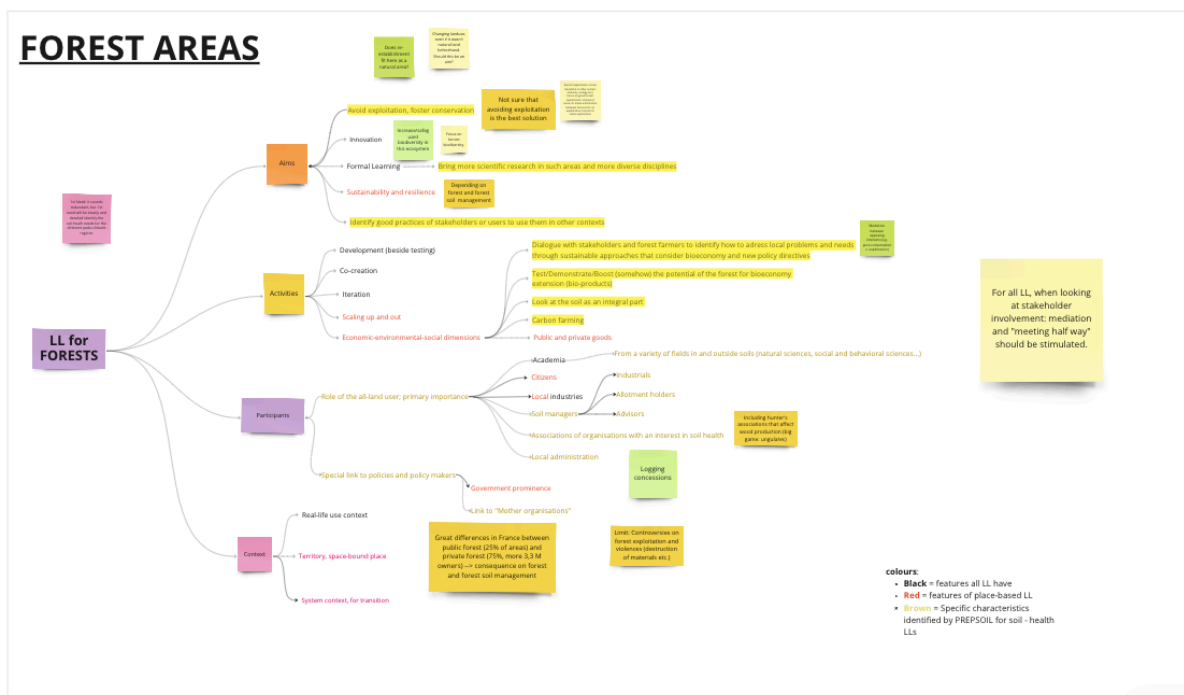




Figure 3. MIRO Mind map to create the conceptual framework for forestry land use (T4.1)

Phase 3. Co-develop (T4.1&T4.2, September-November 2023)

Conceptual framework co-design (T4.1)

In this phase, the focus shifted from co-design to co-development, refining the outputs of the three earlier T4.1. This involved synthesizing workshop reports on LL features across different land use types and analysing Miro boards visualizations. The conceptual framework took shape through refinement and iteration, incorporating consortium feedback and ensuring diverse perspectives. Gaps and ambiguities were addressed to ensure a comprehensive approach.

This phase was a crucial bridge between collaborative ideation and the development of the “Conceptual framework situating the role of Living Labs in improving soil health”. This framework evaluates and enhances co-creation processes within Mission Soil LLs, delineating nuances and commonalities among LLs for different soil land-use types such as agriculture, forestry, urban environments, and natural sites. This document, included in this deliverable in ANNEX 5. Conceptual framework situating the role of living labs to improve soil health for sake of completeness of this document, will be made publicly available as a standalone reference through the PREPSOIL Zenodo Community¹⁰ and PREPSOIL Knowledge Hub¹¹.

Special attention was given to aligning with the Soil Mission Implementation Plan and the criteria for selecting individual LLs and LHs, ensuring the taxonomy closely aligns with the mission's objectives. This deliverable not only aligns with but also advances the mission's knowledge and goals.

Special attention was given to aligning with the Soil Mission Implementation Plan and the criteria for selecting individual LLs and LHs, ensuring the conceptual framework and future taxonomy closely align with the mission's objectives while contributing to its further definition and classification for knowledge and understanding advancement.

Mapping co-design (T4.2)

Alongside, drawing from previous mapping and analysis, several key components were co-developed, leading up to the release of the second version of the PREPSOIL map (Figure 4) released in June 2023.

Not having yet assessed the alignment to the mapped potential LLs, LH, or LL/LHs, the term “initiative” has been introduced to allow on one side the clear distinction of such initiatives from those directly funded under the Mission Soil dedicated funding opportunities, as well as on the other side not lead to misinterpretation of the actual alignment to the Mission Soil criteria. This change was endorsed through input from the Mission Secretariat and European Research Executive Agency (REA) in several meetings and in alignment with EC criteria.

In parallel, to continue and expand the mapping of LL/LHs initiatives, a self-registration form has been developed and integrated on the PREPSOIL website to identify additional initiatives to be included on

¹⁰ PREPSOIL Community on Zenodo - <https://zenodo.org/communities/101070045>

¹¹ <https://prepsoil.eu/knowledge-hub>

the map. Such form collects key details necessary for the integration on the online atlas such as initiative name, location, soil type focus (Agriculture, Forestry, Natural, Urban, Other), contact information, website, and description. It also features automatic geolocation and allows linking "experimental sites" (ES) to main initiatives during registration.

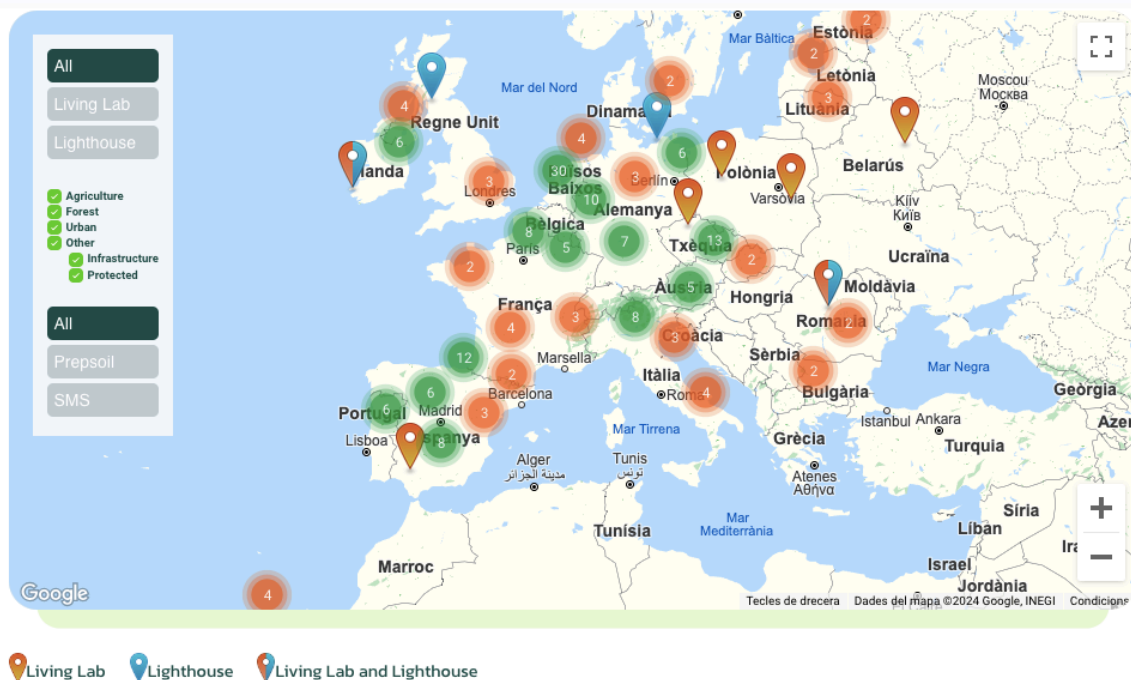


Figure 4. PREPSOIL map of Soil LLs and LHs initiatives version 2, June 2023.

A process for quality review of self-registered initiatives has also been defined by T4.2 partners. Before integration on the map each initiative undergoes a review process performed by T4.2 partners under ENoLL leadership and in collaboration with Trust-IT to ensure the correctness and appropriateness of data for the technical implementation on the webpage.

Phase 4. Evaluate and Understand (T4.1&4.2, November 2023 - February 2024)

This phase covers the first cycle of implementation and initiating the second one. On one side, partners evaluated the T4.1 conceptual framework, while on the other side, a new understanding process has begun, analysing the context and incorporating insights from new Mission Soil projects that have started their activities in the meantime.

The evaluation involved gathering insights on the different land use types, focusing on context and characteristics. This phase also reviewed insights from various PREPSOIL WPs, particularly WP2, which aimed to outline and conduct a soil needs assessment in example regions across Europe to support future LL research and co-creation activities. The review focused on understanding the differences between regions in Europe in terms of soil properties, land use types, environmental zones and socio-economic conditions. More details about this can be found in D2.1 "Synthesising soil needs and drivers across Europe and land use types" (Bayer et al., 2023).



Additionally, the project performed a new literature review on the needs of LLs and LHs, their classification, and evaluation to inform the PREPSOIL taxonomy. Findings emphasized the need for criteria and indicators focused on activities and values to identify suitable organizations for networks of LLs and research infrastructures promoting the agroecology transition in Europe (Gödel et al., 2023). Effective assessment methods for LLs stress evaluating internal functions such as joint experimentation, learning, and co-creation of solutions, while examining barriers and opportunities for sustainable practices (Bouwma et al., 2022). Lastly, the research advocates for a LL comprehensive, stakeholder-inclusive, and iterative approach to support the transition to sustainable soil health across Europe (Vervoort et al., 2023).

Finally, T4.2 expanded their understanding of new project and initiatives both within and beyond the Mission Soil for the collaboration or alignment in the development of the PREPSOIL taxonomy. This involved studying planned actions and outputs of projects like WATERMINING and VITALISE and initiating the collaboration with the SOILL-Startup project through bilateral exploratory meetings.

Phase 5. Co-design (T4.2, February-June 2024)

The second co-design phase focussed on translating conceptual framework and its assessment into the PREPSOIL taxonomy through a series brainstorming sessions conducted within PREPSOIL T4.2 partners as well as with SOILL-Startup project, both within the SOILL-Startup Pilot Working Group and through bilateral sessions with SOILL-Startup partners.

Co-designing the taxonomy framework in T4.2

T4.2 partners (ENoLL, INRAE, WR, DELTARES, SLU, ÖMKi, AU, CSIC, NIBIO, ZALF, LESP, IUNG, RE-SOIL, FUNDECYT-PCTEX, ACR+, COPA-COGECA, and JRC) collaborated to draft the key criteria of the PREPSOIL taxonomy. This co-design effort included the decision to adopt the criteria for LLs and LHs of the Soil Mission Implementation Plan as the macro categories forming the taxonomy's basis and the identification of the taxonomy macro-structure over four levels, each varying in degree of specificity (further detailed in Chapter 3. PREPSOIL taxonomy).

A core element of the co-design phase involved the assessment and prioritization of land-use types. While PREPSOIL WP2 identified six land-use types (agriculture, forestry, industry, mixed, natural, and urban), for the taxonomy purposes it has been agreed to reduce such list to four types. This decision was driven by the need of avoiding unnecessary complexity (e.g., the mixed land-use features can be derived from the consideration of multiple land-use in the taxonomy), as well as to ensure consistency in the services and guidance tools provided by PREPSOIL for LLs and LHs (including the Business Model - T4.3 (Cerezo et al., 2024), and the service package – T4.4) as well as to the support and training material provided by the NATI00NS project to LLs and LHs applicants.

The retained land-use types thus include:

- **Agriculture:** covering (non)perennial cropland, grassland and agroforestry as identified in PREPSOIL WP2.



- **Forestry/Natural:** merging forestry and natural into a combined category, in alignment to the information provided by NATI00NS to applicants (Osimanti et al., 2023).
- **(Peri-)Urban:** redefining “urban” as “(Peri-)urban” to encompass areas on the periphery of urban centres, which are significant for soil health considerations due to their unique environmental interactions and human activities.
- **(Post-)Industrial:** redefining “Industrial” as “(Post-)industrial” to encompass areas that have undergone industrial use or are transitioning from industrial activities.

Understanding: collaboration PREPSOIL-SOILL

T4.2 partners collaborated in the context of the ENoLL-led SOILL-Startup Pilot Group, which brings together partners from the two sister projects, soil and LL experts, Mission Soil Board members, and representatives of other Mission Soil projects like SoilDiverAgro¹². The PREPSOIL - SOILL-Startup collaboration aimed to ensure the harmonized development and alignment between the PREPSOIL taxonomy and mapping criteria and the SOILL-Startup assessment framework for monitoring and reporting on the deployment of funded Living Labs and Lighthouses.

PREPSOIL have contributed to the first SOILL Pilot Group meeting on April 30th, 2024, where key chapters, criteria, and KPIs for monitoring LLs and LHs were discussed and evaluated taking into account the need for clarity and measurability. Beside the actual meetings, PREPSOIL further contributed to the SOILL Pilot Working Group through the offline evaluation of the identified KPIs through the analysis of their relevance, clarity, and measurability (analysis performed through a Miro board, shown in Figure 5).

Additionally, several brainstorming sessions between PREPSOIL and SOILL-Startup partners (under ENoLL coordination as lead of mapping and monitoring activities in both projects) focussed on further classifying LLs and LHs, both current and emerging. This exercise aimed to establish unified and harmonised terminology and classification of LLs and LHs under the Mission Soil that:

- is open to a wider set of initiatives beyond those specifically funded by the dedicated Mission, expanding the network of soil LLs and LHs across Europe for greater impact,
- clearly recognises initiatives that fully support the Mission Soil objectives and align with its criteria and taxonomy, and
- encourages the growth of initiatives in their early stages.

This classification will help distinguishing on the PREPSOIL map the initiatives aligned with Mission Soil criteria and PREPSOIL taxonomy from those in their early stage. Alongside, it will facilitate understanding which initiatives need further support for growth and how this support can be provided by the SOILL support structure throughout the Mission Soil duration.

¹² SoilDiverAgro - Soil biodiversity enhancement in European agroecosystem” GA: 817819.
<https://cordis.europa.eu/project/id/817819>



Two main key conclusions have been derived by these sessions, driving the further development of the PREPSOIL taxonomy and classification process:

- 1) To avoid over-complicating the classification of LL and LH initiatives across Europe, three main categories were established, distinguishing at first the LLs and LHs funded under the dedicated Mission Soil topics. The remaining initiatives not directly funded by the dedicated Mission Soil topics (currently mapped by PREPSOIL in the online atlas) will be further assessed and classified, distinguishing those fully aligned to the taxonomy and Mission Soil criteria from the emerging ones, that require additional efforts for their full compliance. While the final terminology is still under development, this classification has been also discussed and agreed with the Mission Soil Secretariat. A more detailed description of such classification is provided in Chapter
- 2) 4.1 Soil LLs and LHs classification.
- 3) The SOILL-Startup questionnaire, structured with over 30 questions to regularly assess Mission Soil LLs and LHs, may be discouraging or ineffective for early-stage initiatives. Therefore, a simplified questionnaire is needed to assess all PREPSOIL mapped initiatives and distinguish those in their early stages from those potentially aligning to the taxonomy and Mission criteria. For the latter, solely the assessment through the SOILL-Startup questionnaire will allow the confirmation of full alignment and compliance to Mission Soil criteria and PREPSOIL taxonomy.

Phase 6. Co-develop (T4.2, April – June 2024)

Building on the previous phases results, the second co-development stage focussed on the definition of the PREPSOIL taxonomy and self-assessment form.

Co-development of the PREPSOIL taxonomy

T4.2 proceeded to the co-development of the taxonomy through the collaborative input and data refinement by all partners to ensure its relevance and accuracy for various land use types within LLs and LHs. A matrix was developed through an Excel tool (Figure 6) – designed in the earlier stage along the agreed taxonomy structure (Chapter Phase 5. Co-design (T4.2, February-June 2024) – to identify key elements, attributes, components for mature LLs and LHs in soil health across the different land-use types. The matrix mapped over different columns the taxonomy categories/sub-categories, the land-use type, and suggested characteristics, alongside to partners inputs and feedback to accurately reflect the diverse perspectives, experience and knowledge of the partners.



SUB-CATEGORY (select form the drop-down list)	LAND-USE TYPE	INPUT	SOURCE	PARTNER (select form drop-down list)	Comments (Indicate author of the comment)	Possibility to further categorization
Activities - Co-creation & Participation	(POST)INDUSTRIAL	Contaminants knowledge	T4.1	ENoLL	Linda Waring: please note that knowledge for SLU: this applies to forestry as well - not only all land uses	
Activities - Co-creation & Participation	AGRICULTURE	Tacit and explicit knowledge	T4.1	ENoLL	this applies to forestry as well - not only	
Activities - Co-creation & Participation	AGRICULTURE	Transgenerational knowledge	T4.1	ENoLL	this applies to forestry as well - not only	
Activities - Co-creation & Participation	AGRICULTURE	Knowledge exchange	T4.1	ENoLL	this applies to forestry as well - not only	
Activities - Co-creation & Participation	AGRICULTURE	Connection between agricultural knowledge and innovation ecosystems	T4.1	ENoLL	this applies to forestry as well - not only	
Activities - Co-creation & Participation	AGRICULTURE	Local-community involvement	T4.1	ENoLL		
Activities - Co-creation & Participation	GENERIC	Science policy society interactions (organised or natural)	T1.4	ZALF	Several of the knowledge exchange and co creation/participation will be valid to all the local context	
Activities - Co-creation & Participation	GENERIC					
Activities - Development beyond testing	(POST)INDUSTRIAL	Problemitisation, shared challenges/problems	T4.1	ENoLL		
Activities - Development beyond testing	(POST)INDUSTRIAL	Redevelopment/ regeneration	T4.1	ENoLL		
Activities - Development beyond testing	(POST)INDUSTRIAL	Actual remediation/ risk-based management strategies	T4.1	ENoLL		
Activities - Development beyond testing	(POST)INDUSTRIAL	Trans disciplinary research	T4.1	ENoLL		
Activities - Development beyond testing	AGRICULTURE	Demonstration	T4.1	ENoLL		
Activities - Development beyond testing	AGRICULTURE	Experimental platform for matching research outputs/solutions with needs/problems	T4.1	ENoLL		
Activities - Development beyond testing	AGRICULTURE	In field experiments on research field stations	T4.1	ENoLL	SLU: this applies to forestry as well - not only	
Activities - Development beyond testing	FORESTRY	Protected aspects	T4.1	ENoLL		
Activities - Development beyond testing	FORESTRY	Nature-based solutions approach	T4.1	ENoLL	Margherita Caggiano (re soil): this may apply	
Activities - Development beyond testing	FORESTRY	Offset in regional soil challenges	T4.1	ENoLL		
Activities - Development beyond testing	GENERIC	Multiple-scale work	T4.1	ENoLL		
Activities - Economic-environmental-social di	(PER)URBAN	recycle and reuse existed material	T4.1	ENoLL		
Activities - Economic-environmental-social di	(PER)URBAN	recycle urban soils	T4.1	ENoLL		
Activities - Economic-environmental-social di	(PER)URBAN	recycle urban media	T4.1	ENoLL		
Activities - Economic-environmental-social di	(POST)INDUSTRIAL	Financial sustainability in improvement efforts	T4.1	ENoLL		
Activities - Economic-environmental-social di	FORESTRY	and needs (mediation between opposing interests; e.g. pure conservation vs directives	T4.1	ENoLL		
Activities - Economic-environmental-social di	FORESTRY	products)	T4.1	ENoLL		
Activities - Economic-environmental-social di	FORESTRY	Soil as an integral part	T4.1	ENoLL		
Activities - Economic-environmental-social di	FORESTRY	carbon farming	T4.1	ENoLL	Margherita Caggiano (re soil): this may apply	
Activities - Economic-environmental-social di	FORESTRY	Socio-economic logic of the territory	T4.1	ENoLL		
Activities - Economic-environmental-social di	GENERIC	use of latest technology	T4.1	ENoLL		
Activities - Economic-environmental-social di	GENERIC	investment fund	T4.1	ENoLL		
Activities - Economic-environmental-social di	GENERIC	public and private goods	T4.1	ENoLL		
Activities - Iteration	AGRICULTURE	Scientific validation of farmer's experiences and on-farm research	T4.1	ENoLL		
Activities - Iteration	FORESTRY	Adapted within the local constraints	T4.1	ENoLL	SLU: Applies to agriculture as well.	

Figure 6. Excel document first categorization task

The task involved integrating unique characteristics identified from previous consultations and stakeholder inputs, including those from the SOILL Pilot Working Group and T4.1. These were categorized into relevant LLs and LHs criteria and land use types. Participants reviewed and provided feedback to ensure clarity and alignment. The taxonomy was then enhanced with additional details tailored to specific land use categories, refining sub-categories and incorporating supplementary data to improve comprehensiveness. Further refinement included expert suggestions for additional sub-categories. The final taxonomy detailed in the following section (3. PREPSOIL taxonomy), includes definitions of the main categories and the characteristics of LLs and LHs for soil health across the four identified land-use types.

Co-development of the PREPSOIL self-assessment tool

Once the key elements of the taxonomy had been defined and in parallel to the final refinement, the partners turned to developing the PREPSOIL self-assessment form, designed in alignment to the taxonomy, to help differentiate between current and emerging LLs and LHs and to support stakeholders in evaluating their alignment with Mission criteria while identifying areas for improvement. This development was closely coordinated with the SOILL-Startup project to ensure consistency in approaches and terminology.

Starting from the defined taxonomy and the KPIs defined in collaboration with the SOILL-Startup pilot group, information was distilled into straightforward questions with various formats—open-ended, closed, single-choice, or multiple-choice—simplifying the taxonomy's main categories (primarily from Level 1 and Level 2 presented in Figure 8) into practical assessment questions. Two sets of questions were created, tailored for LLs and LHs respectively, to highlight their specific needs and developmental stages as further detailed in Chapter 4.2 PREPSOIL self-assessment form and presented in ANNEX 2. Self-assessment tool.

Along with the form development, T4.2 partners focused on identifying the most suitable way to best include the self-assessment in the registration and mapping process already in place. To streamline user experience and reduce dropout risks, it was agreed to integrate the self-assessment into the registration form as a single questionnaire. This will facilitate quicker classification of initiatives while minimizing the user burden.

Depending on the organization type selected during registration (LL, LH, Experimental site, or LL with LH/experimental sites), the relevant self-assessment questionnaire will be displayed. In the case of LL with LHs/experimental sites, both questionnaire for LLs and LHs/ES will be requested. Initiatives already registered on the PREPSOIL map will be requested to complete the self-assessment only, in alignment with the expectations outlined in the registration form disclaimer, which informed participants of this additional step during the initial registration phase.

LLs and LHs initiatives mapping (T4.2)

In June 2024, the third version of the PREPSOIL map has been released including 122 experimentation sites, LLs, and LHs (Figure 7. PREPSOIL map of Soil LLs and LHs initiatives version 3, June 2024.. This release incorporated new initiatives registered through the PREPSOIL self-registration form, as well as the updated, corrected, and harmonized information of previously mapped initiatives, cleaned of the inactive or unrelated ones as detailed in MS5 Guidelines for mapping LLs/LHs (ANNEX 4. Related milestone reports). Adjustments were made to the map's features based on discussions with the European Commission (EC) and task participants, including the removal of the "Living Lab Centre" and "EU funded" filters and the replacement of the "natural" category with a simplified "land-use types" filter: agriculture, forestry, industry, urban, and other.



Figure 7. PREPSOIL map of Soil LLs and LHs initiatives version 3, June 2024.



The map will be quarterly updated to reflect the newly registered initiatives after necessary quality review of data completion and correctness. To reflect the classification of such initiatives along the three-level system, a possible release of a new and final map may be considered by the end of the project. For this, additional exchanges with SOILL-Startup and Mission Secretariat will be necessary to ensure the balance between the open sharing of information with the need of encouraging those initiatives not yet aligned to the Mission Soil criteria and PREPSOIL taxonomy.

Phase 7: Evaluate (beyond PREPSOIL)

This taxonomy will undergo further evaluation through actual implementation, assessing its effectiveness in real-world settings. This phase will specifically gauge how usable and applicable the taxonomy is for initiatives to LLs and LHs, or the LLs and LHs in soil health. Consequently, implementation will proceed with the use of a self-assessment form to assist initiatives in reflecting on their soil health practices (see Chapter 4. LLs and LHs classification and assessment, for more details). This tool facilitates application and feedback, allowing users to evaluate the taxonomy's relevance and practicality.

However, the broader and more extensive implementation by future LLs and LHs will extend beyond the scope of PREPSOIL. This ongoing process will be supported and carried forward by other initiatives, particularly within the SOILL framework. By continuing this effort, SOILL will ensure the taxonomy evolves and stays relevant, adapting to new insights, emerging challenges, and advancements in soil health. This will be achieved through the SOILL-Startup harmonized assessment method and the development of KPIs designed to monitor soil LLs and LHs, enhancing their impact and sustainability. This ongoing commitment will continue to validate and improve the taxonomy's usefulness and significance for existing and emerging LLs and LHs in soil health.



3. PREPSOIL taxonomy

3.1 Overview of the taxonomy

The PREPSOIL taxonomy of Mission Soil LLs and LHs is a tool to support the identification and classification of initiatives aligning to the LLs and LHs principles that are working towards soil health in alignment to the Mission Soil Implementation Plan and criteria.

The taxonomy is structured across four levels, each referring to a different aspect of categorization, as depicted in Figure 8:

- **Level 1** corresponds to criteria for selecting individual LLs and LHs detailed in the Soil Mission Implementation Plan, namely, aims, activities, participants, and context.
- **Level 2** corresponds to a further refining of Mission Soil criteria into sub-criteria and specifications.
- **Level 3** refers to generic criteria applicable to all types of soil health LLs and LHs.
- **Level 4** contains further specification of criteria applicable only to LLs and LHs operating in and targeting specific land-use types.



Figure 8. Outline of the structure of PREPSOIL taxonomy of Soil Health Living Labs and Lighthouses

While this chapter is presented in a narrative format and as part of the overall deliverable with a report-oriented approach, extracts of this chapter is provided in ANNEX 1. as a standalone guideline. Aiming to be a guidance on the use of the taxonomy, the annex describes its usability for LLs and LHs, presenting the different identified categories, and presenting how the criteria be useful for LLs and LHs.



3.2 Definition of categories

PREPSOIL taxonomy is structured along the main four chapters of the criteria for selection and set-up of living labs (LL) in the context of the Mission Soil (Level 1), as defined in the Soil Mission Implementation Plan:

1. Aims
2. Activities
3. Participants
4. Context.

For each of these chapters, additional sub-categories have been further defined based on the four-level of the taxonomy presented above (3.1 Overview of the taxonomy).

Each chapter and the related sub-categories are presented in the following section in summary tables.

Aims

The first chapter of Mission Implementation criteria (Level 1) refers to the “aims” driving the work of LLs and LHs in the Mission Soil context.

The proposed taxonomy further breaks down this criterion into four sub-criteria and 12 sub-categories as presented in Figure 9 and defined in Figure 10.

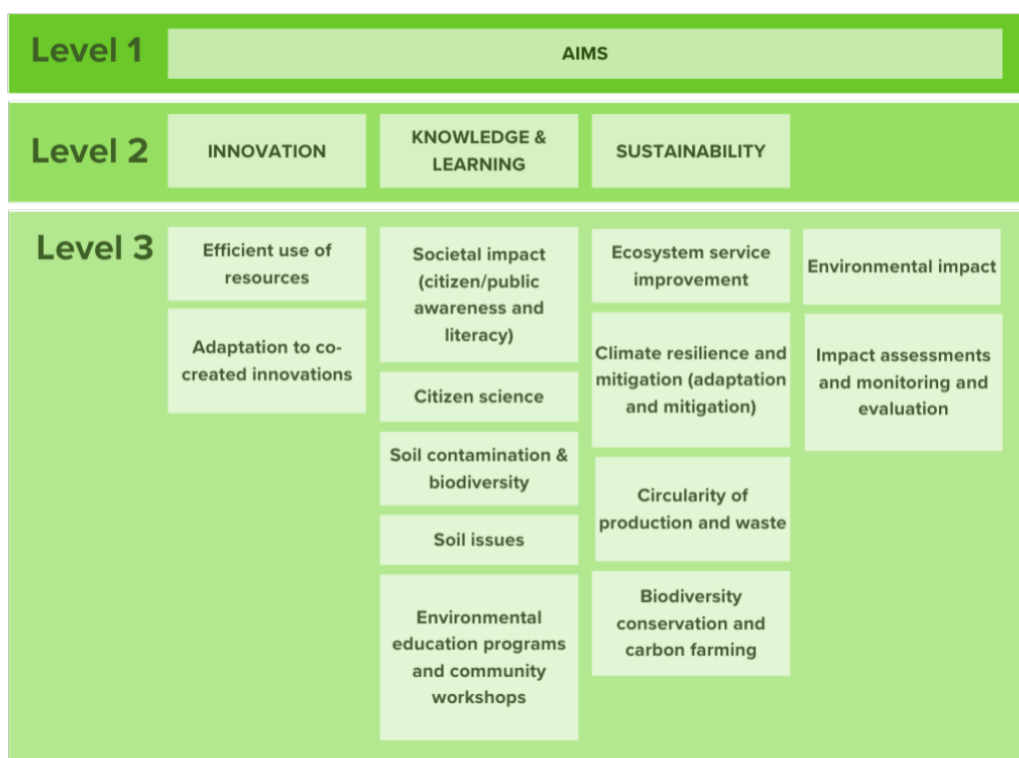


Figure 9. PREPSOIL taxonomy structure: Aims and related subcategories.



REF	CATEGORY	DEFINITION
1.0	AIMS	Designing and implementing forward-thinking, sustainable approaches to soil management that meet human demands while ensuring long-term soil health and productivity.
1.1	INNOVATIONS	Creating and implementing new ideas, methods, or solutions to improve soil health and management practices.
1.1.1	Efficient use of resources	Utilizing technologies and practices that optimize the practices of the LL/LH. For instance, the use of water and renewable energy to enhance soil health and productivity.
1.1.2	Adaptation to co-created innovations	Implementing and refining innovations developed collaboratively with stakeholders to meet specific soil health challenges
1.2	KNOWLEDGE & LEARNING	Activities centred around the acquisition and dissemination of knowledge and information essential for fulfilling the specific objectives of the LLs/LHs.
1.2.1	Societal impact	Enhancing public awareness and literacy regarding soil health and its importance to society.
1.2.2	Citizen science	Engaging the public in scientific research and monitoring of soil health to gather data and foster community involvement.
1.2.3	Soil issues	Tackling problems that affect soil health and productivity in terms of climate adaptation and mitigation. To exemplify some problems can be carbon storage, desertification, forest growth, erosion, soil pollution...
1.2.4	Environmental education programs and community workshops	Providing educational opportunities and workshops to inform and engage communities about soil health and sustainable practices.
1.3	SUSTAINABILITY	Goals or solutions within LLs/LHs that emphasize long-lasting, environmentally friendly practices and outcomes for soil health.
1.3.1	Ecosystem service improvement	Enhancing the benefits provided by ecosystems, such as nutrient cycling and water filtration, through improved soil management practices.
1.3.2	Climate adaptation and mitigation	Developing strategies to adapt to and mitigate the impacts of climate change on soil health.
1.3.3	Circularity of production and waste	Implementing closed-loop systems where waste products are reused, reducing the environmental impact and enhancing soil health.
1.3.4	Biodiversity conservation and carbon farming	Promoting practices that conserve biodiversity and sequester carbon in soils to combat climate change and enhance ecosystem health.
1.4	GOOD PRACTICES	Ways of identifying, documenting, and sharing effective methods and strategies employed by LLs/LHs that contribute to their success and can serve as models for similar initiatives.
1.4.1	Environmental impact	Evaluating the effectiveness of soil health initiatives through systematic monitoring and assessment processes.
1.4.2	Impact assessments and monitoring and evaluation	Activities focused on advancing innovations from initial testing to full-scale application, ensuring solutions are effectively tailored to real-world soil health improvement needs.

Figure 10. Definition of AIMS category and related sub-categories. For a high-resolution image, please visit this [link](#).

Activities

The second chapter of the Mission Implementation criteria (Level 1) focusses on the “**activities**” that LLs and LHs in the Mission Soil context should perform.

The proposed taxonomy further breaks down this criterion into seven sub-criteria and 25 sub-categories as presented in Figure 12 and defined in Figure 11.



BP	CATEGORY	DEFINITION
20	ACTIVITIES	Progressing innovations from pilot stages to broader implementation to address potential soil health improvements.
21	DEVELOPMENT BEYOND TESTING	Utilizing robust process methodologies to enhance soil health and improve outcomes.
21.1	Multi-stakeholder solutions approach	Collaborating with various entities and disciplines to create comprehensive strategies for soil health improvement.
21.2	Multiple scale water management strategies (conservation)	Implementing soil health innovations developed collaboratively with stakeholders to meet specific soil health challenges.
21.3	Management strategies	Collaborative efforts between various stakeholders to design/implement soil health solutions, emphasizing the value of farmer participation and their commitment to quality regional outcomes. Consideration of development of experimentation.
22	COOPERATION & PARTICIPATION	Cooperation involves engaging all stakeholders in decision-making, understanding their unique goals, and ensuring that goals are aligned and mutually beneficial. It involves building trust and understanding between stakeholders and ensuring that all voices are heard. It also involves creating a shared vision and working together to achieve common goals. This collaborative approach enhances understanding and promotes better soil health outcomes among stakeholders.
22.1	Knowledge exchange	Focuses on the needs and perspectives of the primary users of soil health solutions across the agricultural landscape.
22.2	Man, community and nature	Strengthening the abilities of individuals and organizations to manage soil health effectively while focusing on needs of the people of the U.S.
22.3	Capacity building	Strengthening capabilities, user capacity and encouraging open discussions to identify and address shared challenges and issues related to soil health.
22.4	Strategic and institutional	The process of continuously refining and updating soil health strategies through regular cycles of funding, feedback, and improvement, ensuring resilience to changing conditions and needs.
23	REGULATION	Establishing mechanisms for regular feedback to inform long-term soil health practices.
23.1	Feedback loops	Activities consider the implications of when changes in soil conditions affect crop growth and microbial activity (among others) which occur upon soil health practices. Practices help enhance soil quality, reduce negative inputs/outputs.
23.2	Alignment with existing regulatory/policy instruments/funding	Ensuring that all soil health initiatives comply with relevant regulations and policy frameworks and align with policy.
23.3	Soil health evaluation	Using scientific methods to assess and verify the effectiveness of soil health practices and measure improvement.
24	SCALING UP AND OUT	Expanding the implementation of effective soil health practices across landscapes. Scaling refers to increasing the implementation of successful practices across a larger area. It involves identifying the needs of various stakeholders and ensuring that the practices are adapted to different contexts, leading to widespread soil health.
24.1	Up-scaling activities	Involving public awareness and spreading information through various channels and outreach activities aimed at increasing the level of implementation of strategies on practice public scale.
24.2	Advisory system and technical innovations	Developing large scale tools/innovations to address the financial feasibility, environmental sustainability, and social acceptability of soil health solutions, aiming to reduce agricultural outcomes.
24.3	Awareness raising, technical dissemination outreach (public events)	Engaging with public/private/public-private partners to identify and secure financial resources to support soil health initiatives.
25	ECONOMIC, ENVIRONMENTAL, SOCIAL, INSTITUTIONAL	Developing and implementing economic models that promote social stability and sustainable practices.
25.1	Funding sources	Creating business models that ensure the long-term financial viability of soil health initiatives.
25.2	Economic models and voluntary economic	Balancing the benefits of soil health initiatives to various stakeholders and private gains.
25.3	Business models and financial sustainability	Testing and validating business models to assess the effectiveness and impact of soil health initiatives, guiding future actions and adjustments.
25.4	Public and private goods	Implementing systems and processes to regularly monitor soil health and the progress of stakeholders.
26	MEASUREMENT	Conducting ongoing soil health assessments across soil health practices are effective ways to do so.
26.1	Monitoring process systems/ technologies	Using open-source tools/methods to verify the success and applicability of soil health initiatives.
26.2	Field and Testing evaluation	Establishing specific metrics/measures for assessment and impact of soil health efforts.
26.3	Soil health evaluation	Using models to predict and understand the impacts of various practices on soil health.
26.4	Progress indicators	Establishing specific metrics/measures for assessment and impact of soil health efforts.
26.5	Modeling soil health efforts	Using models to predict and understand the impacts of various practices on soil health.
27	COORDINATION	Coordinating efforts, resources, and stakeholders to streamline activities towards shared soil health goals, ensuring effective collaboration and efficient resource allocation.
27.1	Network strategies	Implementing strategies to build and strengthen networks that support soil health initiatives.
27.2	Tools of coordination	Ensuring coordination and collaboration at different scales from local to regional to global to address comprehensive soil health solutions.
27.3	Interregional knowledge & innovation collaborations and opportunities	Increasing regional knowledge and building stronger collaborations to enhance soil health outcomes through shared perspectives and shared solutions.

Figure 11. Definition of ACTIVITIES category and related sub-categories. For a high-resolution image, please visit this [link](#).

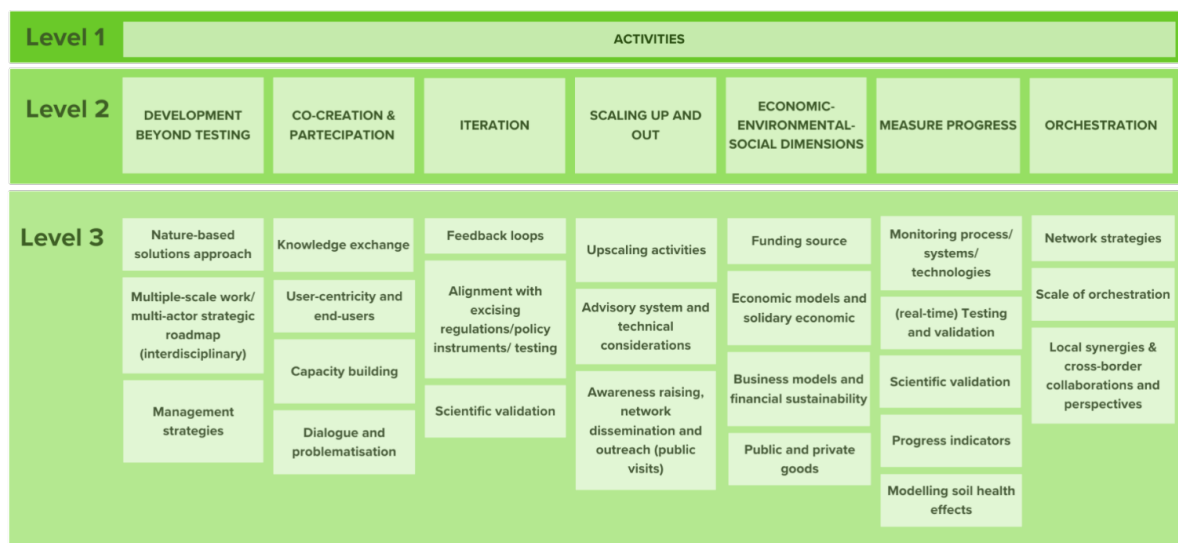


Figure 12. PREPSOIL taxonomy structure: Activities and related subcategories.

The third chapter of Mission Implementation criteria (Level 1) focusses on the “participants” that LLs and LHs in the Mission Soil context need engage and involve in the LL/LHs initiatives. In alignment to the quadruple helix model (Carayannis & Campbell, 2009), the proposed taxonomy further breaks down this criterion into four sub-criteria and 16 sub-categories as presented in Figure 13 and defined in Figure 14.

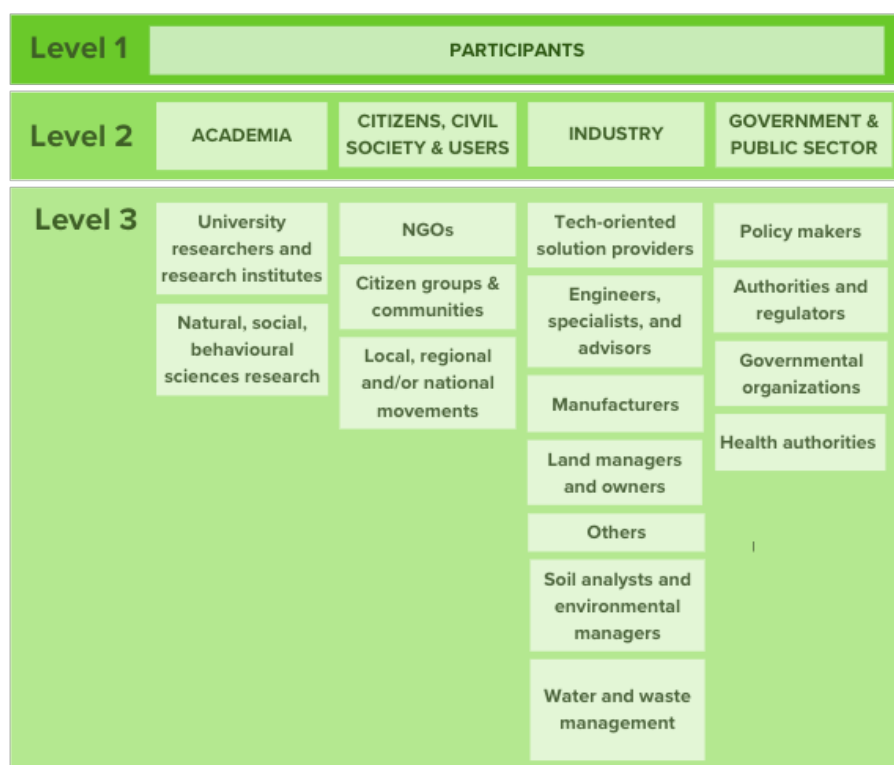


Figure 13. PREPSOIL taxonomy structure: Participants and related subcategories



REF	CATEGORY	DEFINITION
3.0	PARTICIPANTS	The public-people partnership involving Individuals and groups involved in the design, implementation, and evaluation of soil health initiatives from four groups: science, policy, practice and citizens.
3.1	ACADEMIA	Schools, colleges, universities, research institutes, and innovation labs of all types (the public, private, or civil sectors).
3.11	University researchers and research institutes	Experts and institutions focusing on soil science, economics, social sciences, and other relevant fields contributing to soil health research and innovation.
3.12	Natural, social, behavioural sciences research	Research in natural, social, and behavioural sciences that informs and supports soil health initiatives.
3.2	CITIZENS, CIVIL SOCIETY & USERS	Non-profit formal organizations - NGOs, charities, foundations, associations, trade unions & social entrepreneurs when not profit-seeking & more informal & loosely organized communities, citizens, interest groups & movements.
3.2.1	NGOs	Non-governmental organizations involved in advocating for and implementing soil health initiatives.
3.2.2	Citizen groups & communities	Local groups and communities actively participating in soil health projects and initiatives.
3.2.3	Local, regional and/or national movements	Grassroots movements and larger organizations working at local, regional, and national levels to promote soil health.
3.3	INDUSTRY	Firms, companies, entrepreneurs, Small and Medium-sized Enterprises (SMEs), corporates, profit-seeking organizations operating in the market, including commercial ICT & technology sectors, representatives of these stakeholders like employers and trade organizations.
3.3.1	Tech-oriented solution providers	Companies and organizations offering technology-based solutions for soil health.
3.3.2	Engineers, specialists, and advisors	Professionals providing technical expertise and advice on soil health practices and innovations.
3.3.3	Manufacturers	Companies producing equipment and materials used in soil health management.
3.3.4	Land managers and owners	Individuals and organizations responsible for managing and owning land, implementing soil health practices.
3.3.5	Others	Other industry stakeholders involved in soil health initiatives.
3.3.6	Soil analysts and environmental managers	Soil analysts test soil properties to guide agricultural and land use decisions, while environmental managers develop strategies for sustainable resource use and pollution control.
3.3.7	Water and waste management	Water and waste management involves the efficient use, treatment, and disposal of water and waste materials. It ensures clean water supply, sanitation, and the safe handling and reduction of waste to protect public health and the environment.
3.4	GOVERNMENT & PUBLIC SECTOR	Public administration representatives and policymakers, public service providers from local, regional, national & international authorities & regulatory agencies, including research-performing organisations when policy-driven.
3.4.1	Policy makers	Agencies responsible for creating and enforcing regulations related to soil health.
3.4.2	Authorities and regulators	Individuals and organizations involved in developing policies that impact soil health.
3.4.3	Governmental organizations	Local government bodies like municipalities, regional or local governments engaged in soil health.
3.4.4	Health authorities	International organizations and local bodies working on soil health issues across borders. For instance, public health systems and epidemiologists.

Figure 14. Definition of PARTICIPANTS category and related sub-categories. For a high-resolution image, please visit this [link](#).



Context

The fourth chapter of Mission Implementation criteria (Level 1) focusses on the “context” that LLs and LHs in the Mission Soil context operate with and need to consider for the set up and implementation of their LL/LH. The proposed taxonomy further breaks down this criterion into three sub-criteria and 9 sub-categories as presented in Figure 15 and defined in Figure 16.

Level 1	CONTEXT		
Level 2	PHYSICAL BOUNDARIES	SYSTEM CONTEXT	POLICY AND GOVERNANCE
Level 3	Infrastructure: project level, LL level, network level	Time frames	Internal organization
		Social values and norms	Land and natural resource policies & directives
		Land and natural resource management	Decision-making process
		Socio-economic context	Science-policy society interface

Figure 15. PREPSOIL taxonomy structure: Context and related subcategories.



REF	CATEGORY	DEFINITION
4.0	CONTEXT	The circumstances that form the setting of a LL/LH.
4.1	PHYSICAL BOUNDARIES	The geographical or organizational scale at which LLs/LHs conduct their activities, determining the scope and reach of soil health interventions.
4.1.1	Infrastructure: project level, LL level, network level	The physical, technological, and organizational resources and facilities necessary for the execution of soil health projects at various levels: individual projects, LLs, and the network of LLs and LHs.
4.2	SYSTEM CONTEXT	The comprehensive framework that includes the specific elements, boundaries, interconnections, interactions, and operational environment that define and influence the functioning of soil health systems.
4.2.1	Time frames	The various temporal scales over which soil health initiatives are planned, implemented, monitored, and evaluated, encompassing short-term, medium-term, and long-term periods.
4.2.2	Social values and norms	The collective beliefs, practices, and cultural standards that shape community attitudes and behaviours towards soil health and sustainability practices.
4.2.3	Land and natural resource management	The strategies and practices employed to sustainably manage land and natural resources, ensuring their health, productivity, and ecological balance.
4.2.4	Socio-economic context	The social and economic conditions, including demographics, economic activities, and community livelihoods, that influence and are influenced by soil health initiatives.
4.3	POLICY AND GOVERNANCE	The regulatory, legal, and institutional frameworks that guide the design, implementation, monitoring, and scaling of soil health initiatives, ensuring compliance and support.
4.3.1	Internal organization	The internal structure and operations of LLs and LHs, including their infrastructure, business models, and strategies for achieving financial sustainability.
4.3.2	Land and natural resource policies & directives	The specific policies, laws, and guidelines that govern the use, management, and protection of land and natural resources, impacting soil health initiatives.
4.3.3	Decision-making process	The procedures and mechanisms through which decisions are made, involving stakeholder engagement, analysis, and consensus-building in soil health initiatives.
4.3.4	Science-policy society interface	The dynamic interaction between scientific research, policy-making, and societal needs and values, aimed at integrating scientific knowledge into practical policy decisions and public understanding regarding soil health and vice versa.

Figure 16. Definition of CONTEXT category and related sub-categories. For a high-resolution image, please visit this [link](#).



3.3 The PREPSOIL taxonomy

The PREPSOIL taxonomy has been summarised in a table format as depicted in Figure 17.

**PREPSOIL taxonomy
for LLs and LHs in the Mission Soil context**

Level 1	Level 2	Level 3	Level 4	Level 5	
Soil	Soil health	Soil structure	Soil structure	Soil structure	Soil structure
		Soil organic carbon	Soil organic carbon	Soil organic carbon	Soil organic carbon
	Soil fertility	Soil fertility	Soil fertility	Soil fertility	Soil fertility
		Soil acidity	Soil acidity	Soil acidity	Soil acidity
	Soil erosion	Soil erosion	Soil erosion	Soil erosion	Soil erosion
		Soil erosion	Soil erosion	Soil erosion	Soil erosion
	Soil salinity	Soil salinity	Soil salinity	Soil salinity	Soil salinity
		Soil salinity	Soil salinity	Soil salinity	Soil salinity
	Soil water	Soil water	Soil water	Soil water	Soil water
		Soil water	Soil water	Soil water	Soil water
	Soil biodiversity	Soil biodiversity	Soil biodiversity	Soil biodiversity	Soil biodiversity
		Soil biodiversity	Soil biodiversity	Soil biodiversity	Soil biodiversity
Soil quality	Soil quality	Soil quality	Soil quality	Soil quality	
		Soil quality	Soil quality	Soil quality	
	Soil quality	Soil quality	Soil quality	Soil quality	Soil quality
		Soil quality	Soil quality	Soil quality	Soil quality
	Soil quality	Soil quality	Soil quality	Soil quality	Soil quality
		Soil quality	Soil quality	Soil quality	Soil quality
	Soil quality	Soil quality	Soil quality	Soil quality	Soil quality
		Soil quality	Soil quality	Soil quality	Soil quality
	Soil quality	Soil quality	Soil quality	Soil quality	Soil quality
		Soil quality	Soil quality	Soil quality	Soil quality
	Soil quality	Soil quality	Soil quality	Soil quality	Soil quality
		Soil quality	Soil quality	Soil quality	Soil quality






Figure 17. The PREPSOIL Taxonomy. Please click [here](#) for a high-resolution consultable image.



For ease of consultation, the high-resolution image of the PREPSOIL taxonomy is also available at a dedicated [link](#).

Alongside, dedicated images for each of the four sections of Level 1 category have been developed and high-resolution images are available for online consultation:

- **Aims** - Figure 18, also visible at the following dedicated [link](#);
- **Activities** - Figure 19, also visible at the following dedicated [link](#);
- **Participants** - Figure 20, also visible at the following dedicated [link](#); and
- **Context** - Figure 21, also visible at the following dedicated [link](#).

PREPSOIL taxonomy for LLs and LHs in the Mission Soil context: AIMS

Level 1	Level 2	Level 3	Level 4			
			Agriculture	Forestry	(Post) Urban	(Post) Industrial
AIMS	INNOVATION	Efficient use of resources	<ul style="list-style-type: none"> Precision tools adapted to sustainable soil management and to small farms Crop rotation Minimizing Manure processing (digestate) 	<ul style="list-style-type: none"> Efficient logging 	<ul style="list-style-type: none"> Restoration farming Reforestation activities Soil sealing and permeability actions Use of silviculture strategies and/or preservation of mosaic of existing buildings Soil seal technologies Use of infiltration ponds 	<ul style="list-style-type: none"> Efficient remediation techniques Nature-based Solutions (NBS) remediation techniques Temporary use of land
		Adaptation to co-created innovations	<ul style="list-style-type: none"> Agroecology transition/innovation Nature-based solutions Diversified farming systems Agroforestry Integrated soil fertility management 	<ul style="list-style-type: none"> Soil Forest applications (Proper use of the fruits of the trees (eg. acorns)) Forest conservation (in implementation of a natural system (ie good practices)) Nature-based on remote landscape 	<ul style="list-style-type: none"> Using soil functions for climate adaptation 	<ul style="list-style-type: none"> Efficient remediation techniques NBS remediation techniques
	KNOWLEDGE & LEARNING	Societal impact (citizen/policy awareness and literacy)	<ul style="list-style-type: none"> Joint initiatives (farm-to-school) 		<ul style="list-style-type: none"> School or community gardens, a school's, local farmers and local municipalities, on using soil functions for climate change and energy transition 	<ul style="list-style-type: none"> Historical/Heritage structure of site
		Citizen science			<ul style="list-style-type: none"> Urban farming Soil indicators Soil infiltration, temperature and moisture 	
Soil contamination & biodiversity		<ul style="list-style-type: none"> Pesticide use 		<ul style="list-style-type: none"> Soil quality in gardens, but also Urban Drainage Infiltration (UDI) (Public space) 	<ul style="list-style-type: none"> Height in non-polluted NBS sustainable remediation techniques 	
SUSTAINABILITY	Soil issues	<ul style="list-style-type: none"> Extreme weather conditions (through water logging) Soil erosion risks 		<ul style="list-style-type: none"> Urban heat island effect Soil sealing 	<ul style="list-style-type: none"> Soil health/quality Soil sealing 	
	Environmental education programs and community workshops	<ul style="list-style-type: none"> Farm visits Agroecology workshops Training at cooperation level 	<ul style="list-style-type: none"> Heritage forests workshops Forest stewardship workshops 	<ul style="list-style-type: none"> School gardens workshops Community garden workshops Municipal awareness on climate change (infiltration of water in soil) 	<ul style="list-style-type: none"> Industrial sites tours Remediation workshops 	
	Ecosystem service improvement	<ul style="list-style-type: none"> Bio-product development Cover cropping, soil erosion measures, biochar, green-manure, crop diversity 	<ul style="list-style-type: none"> Agroforestry systems Nature-based Forest products Reforestation, terracing Forest carbon storage Nature-based Forest litter composting 	<ul style="list-style-type: none"> Native urban farms Pollinator gardens Urban tree planting, green roofs, urban green spaces Greening measures 	<ul style="list-style-type: none"> Industrial composting Carbon capture projects, water control plants, soil stabilization, natural remediation practices Decoding measures 	
GOOD PRACTICES	Climate resilience and mitigation (adaptation and mitigation)	<ul style="list-style-type: none"> Drought resistant crops Soil erosion risks Soil retention 		<ul style="list-style-type: none"> Urban greening (urban parks, urban forests, green roofs and walls) Decoding measures 	<ul style="list-style-type: none"> Collaborative Remediation and reuse of land use Decoding measures 	
	Circularity of production and waste	<ul style="list-style-type: none"> Composting Green-manure Focus on manure use, not fertilizer application 	<ul style="list-style-type: none"> Biogas recycling 	<ul style="list-style-type: none"> Urban recycling hubs Reuse of (renewable) soils 	<ul style="list-style-type: none"> Industrial recycling Reuse of (renewable) soils 	
	Biodiversity conservation and carbon farming	<ul style="list-style-type: none"> Manure and green manure application Zones such as food protected areas, riparian zones 	<ul style="list-style-type: none"> Forest reserves 	<ul style="list-style-type: none"> Urban biodiversity hotspots Urban conservation areas 	<ul style="list-style-type: none"> Industrial carbon credits Industrial biodiversity hotspots 	
GOOD PRACTICES	Environmental impact	<ul style="list-style-type: none"> Organic certification Common Agricultural Policy (CAP) partnership 	<ul style="list-style-type: none"> Sustainable logging practices 	<ul style="list-style-type: none"> Urban organic gardens Use of soils in climate adaptation 	<ul style="list-style-type: none"> Sustainable (de)remediation/ NBS 	
	Impact assessments and monitoring and evaluation	<ul style="list-style-type: none"> Agriculture impact assessment 	<ul style="list-style-type: none"> Forest impact assessment 	<ul style="list-style-type: none"> Urban impact assessment Citizen science 	<ul style="list-style-type: none"> Industrial impact assessment 	



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Figure 18. PREPSOIL Taxonomy: Aims



PREPSOIL taxonomy
for LLs and LHs in the Mission Soil context:
ACTIVITIES

Level 1	Level 2	Level 3	Level 4			
			Agriculture	Forestry	Peri-urban	Post-industrial
ACTIVITIES	DEVELOPMENT BEYOND TESTS	Nature based solutions approach	<ul style="list-style-type: none"> • Regional demonstration • Co learn agricultural research/ field stations • Soil health assessment techniques (e.g. cover cropping, crop rotation) 	<ul style="list-style-type: none"> • Forest restoration projects • Global regional soil challenges • Broad potential of forest bioeconomy extension (for products) 	<ul style="list-style-type: none"> • Urban green infrastructure • Ecosystem services deployment 	<ul style="list-style-type: none"> • Remediation and regeneration • Soil remediation techniques (e.g. phytoremediation, bio remediation, natural attenuation)
		Multiple scale work/ multi-scale strategic roadmap (interdisciplinary)	<ul style="list-style-type: none"> • Interdisciplinary research on sustainable forestry practices 	<ul style="list-style-type: none"> • Cross sectoral Forest management strategies • Collaborative conservation initiatives 	<ul style="list-style-type: none"> • Urban planning integration with environmental goals • Stakeholder engagement in job development 	<ul style="list-style-type: none"> • Integrated industrial site revitalization plans (and urbanization, sustainable soil based land management) • Stakeholder engagement in brownfield redevelopment
		Management strategies	<ul style="list-style-type: none"> • Sustainable farming management plans • Agricultural risk assessment 	<ul style="list-style-type: none"> • Adaptive forest management practices • Forest risk evaluations • Joint forest management 	<ul style="list-style-type: none"> • Brown infrastructure management strategies • Urban risk assessment • Long term soil and water based spatial planning strategies 	<ul style="list-style-type: none"> • Contaminated site management strategies • Sustainable risk based land management • Industrial risk assessment
	CO-CREATION & PARTICIPATION	Knowledge exchange	<ul style="list-style-type: none"> • Test and apply agri-soil knowledge sharing • Transgenerational agriculture knowledge • Agriculture innovation knowledge (bioremediation) 	<ul style="list-style-type: none"> • Test forestry knowledge • Transgenerational forestry knowledge 	<ul style="list-style-type: none"> • Soil and water based urban planning • Research design • Community gardening and urban farming knowledge 	<ul style="list-style-type: none"> • Industrial remediation techniques/ findings • Industrial remediation research
		User centricity and end users	<ul style="list-style-type: none"> • Farmer centre approaches • Participatory agricultural research 	<ul style="list-style-type: none"> • Forest user involvement (e.g. local communities, indigenous groups) 	<ul style="list-style-type: none"> • Community focused urban projects • Resident engagement in urban sustainability 	<ul style="list-style-type: none"> • Involvement of local communities and actors in remediation projects
		Capacity building	<ul style="list-style-type: none"> • Training programs for farmers • Field demonstrations 	<ul style="list-style-type: none"> • Forestry management training • Community forestry education 	<ul style="list-style-type: none"> • Urban sustainability workshops 	<ul style="list-style-type: none"> • Training on industrial remediation techniques
	ITERATION	Dialogue and problematization (shared challenges/problems)	<ul style="list-style-type: none"> • Cooperation meetings • Agricultural unions • Local farm networks 	<ul style="list-style-type: none"> • Mediation between opposing interests (e.g. para conservation vs. exploitation) 	<ul style="list-style-type: none"> • Community planning 	<ul style="list-style-type: none"> • Mediation between opposing interests • Cooperation in food systems / common goods (technical, financial, social, legal) for brownfield remediation
		Feedback loops	<ul style="list-style-type: none"> • Continuous improvement in learning practices 		<ul style="list-style-type: none"> • Iterative urban planning 	<ul style="list-style-type: none"> • Iterative remediation and redevelopment strategies
		Alignment with existing regulatory/policy instruments/ funding	<ul style="list-style-type: none"> • Compliance with agri cultural policies 	<ul style="list-style-type: none"> • Forestry policy alignment 	<ul style="list-style-type: none"> • Integration with urban policies 	<ul style="list-style-type: none"> • Industrial regulation compliance
	SCALING UP AND OUT	Operating activities	<ul style="list-style-type: none"> • Scaling up from pilot field to region • Scaling from farm to large scale production 		<ul style="list-style-type: none"> • Economic model on urban LLs and LHs (implemented by cities) 	<ul style="list-style-type: none"> • Post industrial demonstration activities
Advisory systems and technical considerations		<ul style="list-style-type: none"> • Agricultural advisory systems 	<ul style="list-style-type: none"> • Forestry advisory systems 	<ul style="list-style-type: none"> • Urban planning advisory systems • Case studies of practice 	<ul style="list-style-type: none"> • Industrial site advisory systems • Case studies of practice 	
Assessment, rising, network dissemination and outreach (public visits)		<ul style="list-style-type: none"> • Agricultural extension services • Thematic seminars/workshops of agriculture topics • Media 	<ul style="list-style-type: none"> • Forestry communication awareness • Thematic seminars/workshops of forestry topics 	<ul style="list-style-type: none"> • Urban sustainability campaigns 	<ul style="list-style-type: none"> • Post industrial demonstration activities • Industrial site remediation awareness • Thematic seminars/workshops of industry topics 	
ECONOMIC, ENVIRONMENTAL, SOCIAL DIMENSIONS	Economic results and existing resources			<ul style="list-style-type: none"> • Creating solution systems/plans (Plan/Playground) 	<ul style="list-style-type: none"> • Economic models for remediation/redevelopment (public values of remediation) 	
	Business models and financial sustainability			<ul style="list-style-type: none"> • Saving costs on storage systems, increase of Ecosystem services • Payment schemes for ecosystem services 	<ul style="list-style-type: none"> • Economic models for remediation/redevelopment (private values of remediation) 	
	Public and private goals			<ul style="list-style-type: none"> • Program to enhance private landowners to contribute to common goals (e.g. decreasing gardens, for climate adaptivity) 	<ul style="list-style-type: none"> • Ecosystem practices by private industrial landowners for farm savings 	
RESEARCH PROGRESS	Marketing promises/ systems/ technologies	<ul style="list-style-type: none"> • Carbon marketing • Measurement, Reporting and Verification (MRV) • MRV/C project • Near infrared (NIR) sensors in soil test cheap and quickly relevant results 		<ul style="list-style-type: none"> • SD of soil testing • If responses in the field 	<ul style="list-style-type: none"> • Marketing efficiency of remediation techniques, best practices levels and spreading 	
	Justified funding and validation	<ul style="list-style-type: none"> • Reduce up on farm experimentation 		<ul style="list-style-type: none"> • Co remediation communication towards private site of citizens • Farmer sampling 	<ul style="list-style-type: none"> • Co remediation communication towards private site of citizens • Farmer sampling 	
	Scientific validation			<ul style="list-style-type: none"> • Creating opportunities for University Students to do research in multiple LLs 	<ul style="list-style-type: none"> • Creating opportunities for University Students to do research in multiple LLs 	
	Progress indicators	<ul style="list-style-type: none"> • Increase soil carbon • Increase biodiversity • Consumer demand 		<ul style="list-style-type: none"> • Decrease in SD of tested soil • Increase to if of soil organisms 	<ul style="list-style-type: none"> • Contamination levels and spreading 	
ORCHESTRATION	Modelling soil health effects	<ul style="list-style-type: none"> • Carbon • Nitrogen • Biodiversity • Toxic such as soil-borne food risk 		<ul style="list-style-type: none"> • Biodiversity • Inclusive equity • Organic matter content 	<ul style="list-style-type: none"> • Contamination levels • Inclusive equity • Natural attenuation ability 	
	Network strategies	<ul style="list-style-type: none"> • Agricultural unions • Extension • Farm network/ cooperation 		<ul style="list-style-type: none"> • Set up and work with neighborhood groups • Municipal environmental groups • Citizen groups • Gardening associations • Social Housing organisations 	<ul style="list-style-type: none"> • Set up neighborhood groups, actor groups for regeneration of contaminated and brownfield land • Municipal environmental groups • Citizen groups • Social Housing organisations 	
	Scale of orchestration	<ul style="list-style-type: none"> • Regional/local and national agricultural orchestration 	<ul style="list-style-type: none"> • Forest landscape level orchestration 	<ul style="list-style-type: none"> • City level orchestration on neighbourhood level (also depending on the scale of LL and inhabitants + social coherence) 	<ul style="list-style-type: none"> • Large scale industrial site orchestration 	
	Local synergies & cross border collaborations/ cooperation			<ul style="list-style-type: none"> • Collaboration based on shared problems or goals (e.g. climate proof cities) 	<ul style="list-style-type: none"> • Site based collaboration, region scale collaboration • Collaboration based on shared problems (e.g. emerging common goals) 	



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Figure 19. PREPSOIL Taxonomy: Activities



**PREPSOIL taxonomy
 for LLs and LHs in the Mission Soil context:
 PARTICIPANTS**

Level 1	Level 2	Level 3	Level 4				
PARTICIPANTS	ACCESSORS	CITIZEN, CIVIL SOCIETY & USERS	INDUSTRY	Agriculture	Forestry	(P)er-urban	(P)ost-industrial
				<ul style="list-style-type: none"> University researchers and research institutes Natural, social, behavioural sciences research 	<ul style="list-style-type: none"> Urban production operations Nature organisations Environmental foundations 	<ul style="list-style-type: none"> Urban production operations Nature organisations World Wildlife Fund (WWF) 	<ul style="list-style-type: none"> Urban production operations Nature organisations World Wildlife Fund (WWF)
INDUSTRY	TECH-ORIENTED SOLUTION PROVIDERS	TECH-ORIENTED SOLUTION PROVIDERS	TECH-ORIENTED SOLUTION PROVIDERS	<ul style="list-style-type: none"> Agri-tech companies Agri-tech start-ups Agri-tech incubators 	<ul style="list-style-type: none"> Agri-tech companies Agri-tech start-ups Agri-tech incubators 	<ul style="list-style-type: none"> Agri-tech companies Agri-tech start-ups Agri-tech incubators 	<ul style="list-style-type: none"> Agri-tech companies Agri-tech start-ups Agri-tech incubators
				<ul style="list-style-type: none"> Agri-tech companies Agri-tech start-ups Agri-tech incubators 	<ul style="list-style-type: none"> Agri-tech companies Agri-tech start-ups Agri-tech incubators 	<ul style="list-style-type: none"> Agri-tech companies Agri-tech start-ups Agri-tech incubators 	<ul style="list-style-type: none"> Agri-tech companies Agri-tech start-ups Agri-tech incubators
GOVERNMENT & PUBLIC SECTOR	POLICY MAKERS	POLICY MAKERS	POLICY MAKERS	<ul style="list-style-type: none"> National government Regional government Local government 	<ul style="list-style-type: none"> National government Regional government Local government 	<ul style="list-style-type: none"> National government Regional government Local government 	<ul style="list-style-type: none"> National government Regional government Local government
				<ul style="list-style-type: none"> National government Regional government Local government 	<ul style="list-style-type: none"> National government Regional government Local government 	<ul style="list-style-type: none"> National government Regional government Local government 	<ul style="list-style-type: none"> National government Regional government Local government



Figure 20. PREPSOIL Taxonomy: Participants

**PREPSOIL taxonomy
 for LLs and LHs in the Mission Soil context:
 CONTEXT**

Level 1	Level 2	Level 3	Level 4				
CONTEXT	PHYSICAL BOUNDARIES	SYSTEM CONTEXT	Agriculture	Forestry	(P)er-urban	(P)ost-industrial	
			<ul style="list-style-type: none"> Production chain Demarcation tests 	<ul style="list-style-type: none"> Production chain Demarcation tests 	<ul style="list-style-type: none"> Production chain Demarcation tests 	<ul style="list-style-type: none"> Production chain Demarcation tests 	<ul style="list-style-type: none"> Production chain Demarcation tests
POLICY AND GOVERNANCE	INTERNAL ORGANIZATION	INTERNAL ORGANIZATION	INTERNAL ORGANIZATION	<ul style="list-style-type: none"> Production chain Demarcation tests 	<ul style="list-style-type: none"> Production chain Demarcation tests 	<ul style="list-style-type: none"> Production chain Demarcation tests 	<ul style="list-style-type: none"> Production chain Demarcation tests
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Figure 21. PREPSOIL Taxonomy: Context



3.4 How to use the taxonomy

The PREPSOIL taxonomy is designed as a framework to guide and inspire diverse initiatives across varying land-use types. This taxonomy acknowledges the inherent diversity in operational contexts, ecosystems, and stakeholder engagement strategies inherent to LLs and LHs. Consequently, it is not intended to serve as a rigid, prescriptive set of rules. Rather, it functions as a flexible guideline, adaptable to the unique requirements and conditions of each specific context.

By leveraging this taxonomy, practitioners can identify and prioritize relevant characteristics of LLs and LHs in the Mission Soil context that align with their specific case and support the developments and innovations to strengthen the process. This adaptive approach ensures that LLs and LHs can tailor their methods and strategies to local needs and conditions. The taxonomy thus acts as a tool, fostering innovation and sustainability through a contextualized and nuanced application of its principles.

Moreover, this taxonomy encourages continuous learning and adaptation by providing a structured yet flexible framework. LLs and LHs can draw inspiration from a diverse array of practices and experiences documented within the taxonomy, allowing for cross-pollination of ideas and best practices.

Using the taxonomy criteria

The criteria of the PREPSOIL taxonomy should not be viewed as a rigid blueprint or a simple checklist. Instead, they should serve as guidelines for defining the LLs and LHs operational and strategic frameworks, as well as for the regular monitoring and evaluation for learning.

In setting up LL and LH, these criteria, which represent key characteristics of LLs and LHs in the Mission Soil context, should be integrated into and drive the co-design of the LL/LH strategy such as governance, stakeholder identification, implementation plan, business model plan, etc.

Alongside, each criterion acts as benchmark for evaluating current practices and identifying areas for improvement. LLs and LHs should employ these criteria for self-assessment and reflection, enabling them to assess their progress and effectiveness in soil health improvement. This involves a systematic review of each criterion, assessing how current practices align with the benchmarks, and identifying gap areas needing enhancement or higher attention.

Distinguishing between LL and LH

While both LLs and LHs share the goal of enhancing soil health, their approaches to utilizing the taxonomy must align with their distinct roles.

LLs function as collaborative ecosystems where stakeholders engage in research, testing, and co-designing solutions across various real-life settings, land-use types, and soil health issues. They prioritize innovation and iterative learning, adapting to foster new practices across technical, social-economic and governance and biophysical sectors. On the other hand, LHs serve as demonstration sites for soil health solutions. They aim to showcase proven methods and scalable solutions that promote (environmental, social, and economic) sustainability and replicability in diverse environments.



Understanding these distinctions is crucial for LLs and LHs to effectively apply the taxonomy, enhancing their approaches and outcomes in soil health initiatives.

Application and prioritization

Given the PREPSOIL set of criteria, LLs and LHs should adopt a strategic approach in their application and alignment.

It is not necessary for all criteria to be met simultaneously. Instead, stakeholders should prioritize criteria based on their relevance and impact. The establishment of guiding thresholds or targets for each criterion tailored to the unique context of the LL can facilitate this process.

By prioritizing criteria and setting clear thresholds, LLs and LHs can focus on the most critical aspects first. This approach allows for a more manageable and effective implementation of strategies.

Additionally, setting milestones for progressively achieving compliance with all criteria helps promote a balanced and sustainable improvement in soil health. This structured and phased approach ensures that LLs and LHs can systematically address key areas while working towards comprehensive and long-term goals.



4. LLs and LHs classification and assessment

Notwithstanding the guidance nature of the PREPSOIL taxonomy, its practical adoption and the alignment to the identified criteria will define mature LLs and LHs in the context of the Mission Soil. To support the identification and classification of all current and emerging LLs and LHs operating in the Mission Soil context, PREPSOIL has co-created a set of self-assessment questions structured in alignment to the PREPSOIL taxonomy as presented in the following chapter.

4.1 Soil LLs and LHs classification

The categorization of LLs and LHs is a means to support for the implementation and monitoring of the Mission Soil progress, as well to understand the type of services to be provided to ensure the achievement of the Mission goals.

Through a joint discussion performed among SOILL-Startup, PREPSOIL and the Mission Soil secretariat (DG Agri and REA), it has been agreed that LLs and LHs initiatives can be classified along a three-level scale. Besides the mere classification, such framework ensures that LLs and LHs initiatives can be supported in accordance with their stages of development, their alignment to Mission Soil objectives, and their adherence to the PREPSOIL taxonomy. While the final naming of each category is still under development, the three-layer classification is structured as follows:

1) Mission Soil Living Labs and Lighthouses

The first category encompasses LLs and LHs that are specifically funded under the dedicated topics of the Mission Soil. These initiatives are fully compliant with the LL/LH criteria of the Mission Soil further defined in the PREPSOIL taxonomy. These initiative are the primary beneficiaries of the SOILL support structure dedicated actions. Such support also includes the regular monitoring of progresses along the in-depth monitoring framework developed by SOILL-Startup building on and in alignment to the PREPSOIL taxonomy.

2) European Soil Living Labs and Lighthouses

The second category includes LLs and LHs that exist within the broader European landscape that are aligned to the Mission Soil criteria and PREPSOIL taxonomy but do not receive direct funding from the dedicated Mission Soil topics.

The identification and classification of these LLs and LHs is crucial as it allows for the recognition and integration of existing efforts that align with Mission Soil's goals for a larger network of Soil Health LLs and LHs. The proposed taxonomy, along with a self-assessment form, will help to distinguish these initiatives from the preliminary stage initiatives (Type 3).

3) Emerging Soil Living Labs and Lighthouses

The third category consists of potential and emerging LLs and LHs initiatives, including on-the-ground experiments and pilot projects, that have not yet fully aligned with the Mission Soil criteria and PREPSOIL taxonomy. For these emerging initiatives, the taxonomy provides a development roadmap, while the self-assessment form will help these projects identify gaps in their alignment with Mission Soil standards.



4.2 PREPSOIL self-assessment form

The PREPSOIL self-assessment form enables initiatives to evaluate their maturity and alignment to the Mission Soil criteria and PREPSOIL taxonomy. By identifying areas of the PREPSOIL taxonomy needing improvement, the self-assessment form helps LLs and LHs initiatives assessing their progress and uncovering growth opportunities, thus becoming a versatile tool for various contexts, including reviews, milestones, or ad-hoc assessments.

The self-assessment form is designed to complement and integrate the 11 questions of the PREPSOIL self-registration form¹³ with a different set of questions for registered LLs and LHs/experimental sites (ES). 18 questions have been developed for LLs, bringing the total questions to 29 considering also the self-registration ones, while 12 have been designed for LHs and ES, for a total of 23 questions for both registration and assessment. For ease of use and compilation, the form focuses on closed questions (single or multiple choice), with open answers limited to basic figures and information.

Alongside the questions and structure, the form includes “invitation criteria” for filtering initiatives based on their responses, determining which will undergo a more detailed assessment under SOILL-Startup for final categorization as European Soil LLs and LHs (Type 2) or Emerging Soil LLs and LHs (Type 3). The full questionnaire, including questions, answer types, and invitation criteria, is available in ANNEX 2. Self-assessment tool.

Accessible by September 2024 via the PREPSOIL website, the tool will be open to all interested users and distributed to all mapped initiatives under T4.2. New initiatives will complete both the registration and assessment forms, while the 122 already mapped initiatives will only need to complete the self-assessment.

In line with the regular monitoring principle and to timely identify areas for improvement, it is recommended that all initiatives – registered on PREPSOIL or not – perform a regular self-assessment regularly such as on annual or bi-annual basis.

The results from the self-assessment form will be compiled into a report format, presenting the questions and responses for all respondents to review. This report will also include links to related support resources and initiatives such as the PREPSOIL Business Plan for LLs and LHs (Cerezo et al., 2024), the PREPSOIL Service Package for Increased Performance and Accelerated Maturity of LLs and LHs (T4.4, under development), or the SOILL-Startup support activities for Soil LLs and LHs and applicants.

¹³ <https://prepsoil.eu/prepsoil-map-self-registration-form>



5. Conclusions and next steps

This deliverable marks a significant step forward for the PREPSOIL project, aligning with its mission to support the establishment and enhancement of LLs and LHs in the context of the Mission Soil.

Key results and conclusions

At the heart of this document is the **PREPSOIL taxonomy** designed to define, categorize, and guide the set up and development of soil health LL and LH initiatives along a structured approach.

To ensure the harmonized development and growth of the network of Mission Soil LLs and LHs, a well-defined taxonomy is necessary to promote clarity and cohesion among soil health initiative. By categorizing LLs and LHs according to specific land use types – agriculture, forestry/natural, (peri-)urban, and (post-)industrial – the taxonomy enables a precise identification of unique characteristics, criteria, and requirements. This structured approach not only aids in understanding soil health practices, but also fosters knowledge sharing and collaboration among stakeholders and initiatives across Europe, navigating the soil health complexities and align effectively across multiple objectives.

To distinguish the LL and LH initiatives for soil health fully aligned with the PREPSOIL taxonomy and Mission Soil criteria from those in the early stages that require additional efforts for full compliance, a **Soil LL and LH classification** has been agreed in collaboration with the Mission Soil Secretariat and SOILL-Startup project. Such classification is structured along three main categories, distinguishing:

4. **Mission Soil Living Labs and Lighthouses** funded under dedicated topics of the Mission Soil.
5. **European Soil Living Labs and Lighthouses** that are aligned to the Mission Soil criteria and PREPSOIL taxonomy but do not receive direct funding from the dedicated Mission Soil topics.
6. **Emerging Soil Living Labs and Lighthouses** that exist within the broader European landscape that have not yet fully aligned with the Mission Soil criteria and PREPSOIL taxonomy.

To allow the simple and user-friendly distinction of mapped initiatives, the **PREPSOIL self-assessment form** has been designed along the PREPSOIL taxonomy. The Self-assessment form supports the classification of mapped initiatives, distinguishing primarily those not yet aligned to the PREPSOIL taxonomy (category 3) from those potentially aligned (potential category 2). Besides of the classification purpose, such tool will support on one side the identification of services and support needs of the PREPSOIL mapped initiatives across Europe, and on the other sides guide the self-reflection, monitoring, and advancement by the individual registered initiatives.

Next steps

Looking ahead, several key actions are planned.

Before September 2024, the self-assessment form will be made available on the PREPSOIL portal to complement and integrate the self-registration of LLs and LHs initiatives for soil health.

Based on the results, both previously mapped and newly registered initiatives will be assessed and classified. Initiatives potentially aligned to the PREPSOIL taxonomy will be invited to complete the in-depth SOILL-Startup questionnaire to confirm the full alignment and compliance and upgrade of classification to category 2.



Alongside, the PREPSOIL map will be quarterly updated to reflect the newly registered initiatives. A possible release of a new and final map release to reflect the classification along the 3-layer system is still under evaluation.

In addition, the collaboration between PREPSOIL and SOILL-Startup will continue beyond the delivery of this document to facilitate data and information alignment, ensure smooth transitions of map and assessment features, and address data privacy concerns.

Recommendations

A set of key recommendations for different actors are drawn to fully benefit of PREPSOIL taxonomy, mapping, classification, and assessment.

- **LL and LH initiatives**

It is recommended that LL and LH initiatives actively utilize the PREPSOIL taxonomy as a flexible framework to guide their efforts while adapting to their unique contexts and needs. Rather than adhering to a rigid set of rules, practitioners should leverage the taxonomy to identify and prioritize characteristics that align with their specific circumstances and goals. This approach will foster innovation and sustainability by allowing initiatives to tailor their methods to local conditions and engage in continuous learning.

To maximize the benefits of the taxonomy, LL and LH initiatives should regularly map their progress, benchmark performance, and engage in self-reflection. By adopting a monitoring and evaluation for learning approach, initiatives can identify areas for growth, ensure alignment with Mission Soil objectives, and continuously improve their practices in line with the PREPSOIL taxonomy.

- **PREPSOIL and SOILL-Startup**

It is recommended that PREPSOIL and SOILL-Startup maintain ongoing, detailed collaboration beyond the delivery of this document to ensure effective data transfer and alignment between the two initiatives. This continued partnership is essential for achieving a seamless transition of map and assessment features, while also addressing critical data privacy and ethical considerations. By working together, both projects can ensure that the taxonomy and assessment tools remain up to date, adapting to new insights and emerging challenges in soil health, thereby enhancing their relevance

- **PREPSOIL consortium and other Mission Soil Projects**

The PREPSOIL consortium should ensure that the delivery of service packages for LLs and LHs under T4.4 aligns with the PREPSOIL taxonomy to guarantee the delivery of services are relevant and effectively support the growth of LLs and LHs.

In addition, the consortium should consider the alignment to the PREPSOIL taxonomy and assessment results also in other tasks – e.g., the PREPSOIL Mobile App for citizens to support research initiatives (T3.2), the Knowledge Hub with a multi-lingual repository of materials (T3.3) - to ensure the delivery of tools and support materials that support the LLs and LHs development by addressing their diverse needs.

Alongside, the same alignment should be considered by other Mission Soil Projects delivering solutions, tools, and knowledge that could support the LLs and LHs growth and their lead towards healthy soils.

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Building capacities for engagement, outreach and knowledge
PREPSOIL – 2022-2025



For this, effective and regular mechanisms for sharing assessment results data should be established in line with data management procedures and in compliance with ethical provisions for personal data protection.



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ANNEX 1. PREPSOIL taxonomy: a guideline for users

This guideline is intended to support the understanding and use of the PREPSOIL taxonomy designed to help the identification and mapping of initiatives that adhere to the principles of LLs and LHs, working towards soil health in alignment with the Mission Soil action plan and criteria.

Delivered as annex to the related deliverable of the PREPSOIL project (D4.1 “Report on LL/LH taxonomy, identification and mapping feeding the online interactive atlas”), this guideline is intended as an easily digestible and stand-alone document. The document is available on Zenodo¹⁴ and will be published on the PREPSOIL Knowledge Hub¹⁵.



¹⁴ PREPSOIL Taxonomy and Self-assessment for Living Labs and Lighthouses in the Mission Soil context. A guide for users. DOI: 10.5281/zenodo.13255032. <https://zenodo.org/records/13255032>

¹⁵ <https://prepsoil.eu/knowledge-hub>

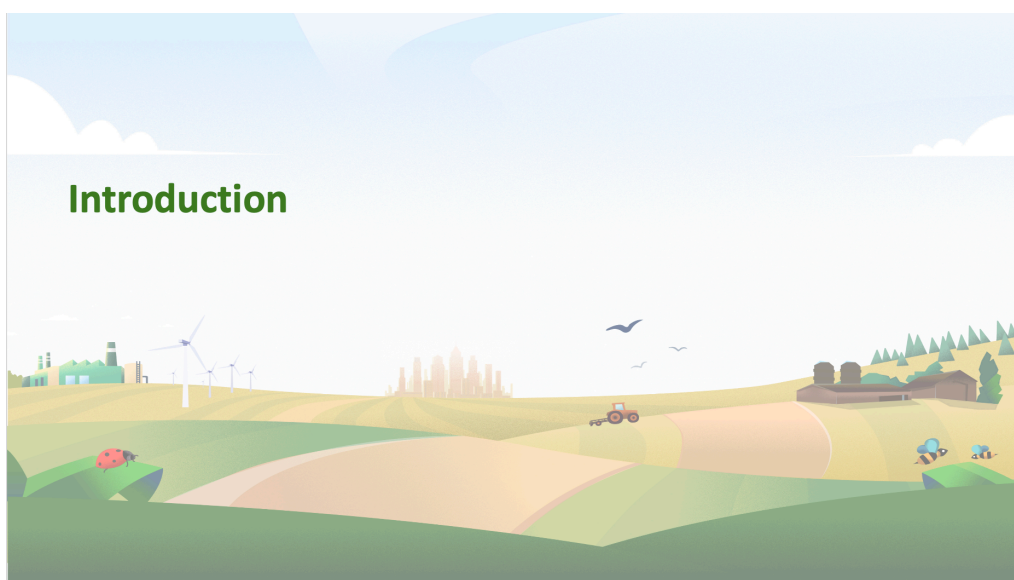


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This document is based on a deliverable not yet approved by the European Commission.



Introduction

Purpose of this document

This guideline is intended to support the understanding and use of the PREPSOIL taxonomy and PREPSOIL self-assessment form for Living Labs and Lighthouses in the Mission Soil context.

PREPSOIL taxonomy

The PREPSOIL taxonomy of Mission Soil Ls and LHs is developed as a tool to support the identification and classification of initiatives aligning to the Ls and LHs principles that are working towards soil health in alignment to the Mission Soil Implementation Plan and criteria.

PREPSOIL self-assessment form

The PREPSOIL self-assessment form enables initiatives to evaluate their maturity and alignment to the Mission Soil criteria and PREPSOIL taxonomy. By identifying areas of the PREPSOIL taxonomy needing improvement, the self-assessment form helps Ls and LHs initiatives assessing their progress and uncovering growth opportunities, thus becoming a versatile tool for various contexts, including reviews, milestones, or ad-hoc assessments.

Delivered as annex to the related deliverable of the PREPSOIL project (D4.1 "Report on LL/LH taxonomy, identification and mapping feeding the online interactive atlas", DOI: 10.5281/zenodo.13151578), this guideline is intended as an easily digestible and stand-alone document.



The Mission “A Soil Deal for Europe”

The Mission “[A Soil Deal for Europe](#)” aims to establish 100 Living Labs (LLs) and Lighthouses (LHs) to lead the transition towards healthy soils by 2030. As part of the Mission Implementation Plan, clear criteria have been established to define the necessary aims, activities, participants, and context such Living Labs and Lighthouses need to align to in the context of the Mission Soil.

The PREPSOIL project

The first project funded under the Mission Soil, [PREPSOIL](#), is dedicated to advancing the Mission's objectives across European regions. It aims to combat soil degradation, enhance soil awareness, and promote soil literacy among key stakeholders.

Through a focus on knowledge transfer and collaborative innovation in regional LLs, the project seeks to deepen understanding of LLs and their pivotal role in improving soil health. Key initiatives include developing a new taxonomy, mapping current and emerging efforts, and delivering a comprehensive service package for LLs and LHs. This package includes model business plans aimed at ensuring the long-term sustainability of these innovative initiatives.

PREPSOIL Taxonomy



Purpose

The PREPSOIL taxonomy for Living Labs (LLs) and Lighthouses (LHs) is a crucial guide for initiatives aimed at improving soil health. This public document offers a detailed framework, outlining categories and sub-categories relevant to LLs and LHs at any stage of development. It helps both new and established LLs and LHs understand their alignment with the Soil Mission Implementation Plan. By providing this structured approach, the taxonomy enables stakeholders to assess progress, identify improvement areas, and stay focused on strategic objectives.

Target audience

The PREPSOIL taxonomy is an inclusive tool designed for anyone interested in enhancing soil health. It primarily targets LLs and LHs initiatives, offering a structured framework for categorizing and evaluating efforts. The audience includes researchers and academics in soil science, policy-makers and regulators shaping agricultural and environmental policies, practitioners and land managers implementing soil health practices, and community organizations and citizens involved in these initiatives.

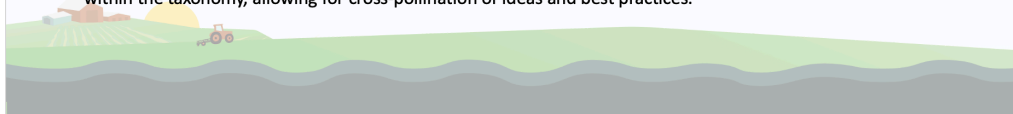


How to use the taxonomy

The **PREPSOIL taxonomy** is designed as a framework to **guide and inspire** diverse initiatives across varying land-use types. This taxonomy acknowledges the inherent diversity in operational contexts, ecosystems, and stakeholder engagement strategies inherent to LLs and LHs. Consequently, it is not intended to serve as a rigid, prescriptive set of rules. Rather, it functions as a **flexible guideline, adaptable to the unique requirements and conditions of each specific context.**

By leveraging this taxonomy, practitioners can **identify and prioritize relevant characteristics of LLs and LHs** in the Mission Soil context that align with their specific case and support the developments and innovations to strengthen the process. This adaptive approach ensures that LLs and LHs can tailor their methods and strategies to local needs and conditions. The taxonomy thus acts as a tool, fostering innovation and sustainability through a contextualized and nuanced application of its principles.

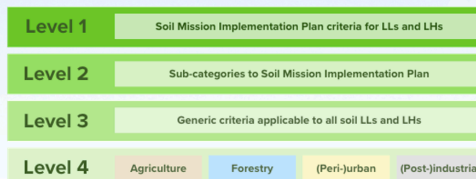
Moreover, this taxonomy encourages **continuous learning and adaptation** by providing a structured yet flexible framework. LLs and LHs can draw inspiration from a diverse array of practices and experiences documented within the taxonomy, allowing for cross-pollination of ideas and best practices.



Structure of the PREPSOIL taxonomy: categories

The PREPSOIL taxonomy is structured across four levels, each referring to a different aspect of categorization:

- Level 1** corresponds to criteria for selecting individual LLs and LHs detailed in the Soil Mission Implementation Plan, namely, aims, activities, participants, and context.
- Level 2** corresponds to a further refining of Mission Soil criteria into sub-criteria and specifications.
- Level 3** refers to generic criteria applicable to all types of soil health LLs and LHs.
- Level 4** contains further specification of criteria applicable only to LLs and LHs operating in and targeting specific land-use types.

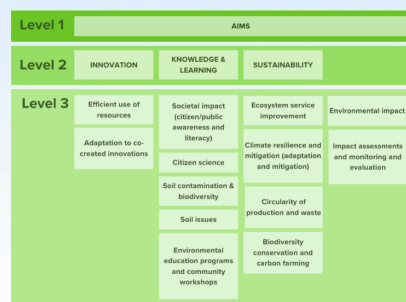


PREPSOIL taxonomy categories: AIMS

The first chapter of Mission Implementation criteria refers to the “aims” driving the work of LLs and LHs in the Mission Soil context.

The proposed taxonomy further breaks down this criterion into four sub-criteria and 12 sub-categories.

Click [here](#) to view a detailed description and definition of AIMS category, criteria and sub-category.





PREPSOIL taxonomy categories: ACTIVITIES

Level 1 ACTIVITIES						
Level 2 DEVELOPMENT BEYOND TESTING		CO-CREATION & PARTICIPATION		ITERATION		SCALING UP AND OUT
Level 3 Nature-based solutions approach		Knowledge exchange		Feedback loops		Up-scaling activities
Multiple-scale work/ multi-actor strategic roadmap (interdisciplinary)		User-centricity and end-users		Alignment with existing regulations/policy instruments/ testing		Advisory system and technical considerations
Management strategies		Capacity building		Scientific validation		Awareness raising, network dissemination and outreach (public visits)
		Dialogue and problematization				Business models and financial sustainability
						Economic models and solidary economic
						Public and private goods
						Monitoring process/ systems/ technologies
						(real time) Testing and validation
						Scientific validation
						Progress indicators
						Modelling soil health effects
						Network strategies
						Scale of orchestration
						Local synergies & cross-border collaborations and perspectives

The second chapter of the Mission Implementation criteria focusses on the “**activities**” that LLs and LHs in the Mission Soil context should perform.

The proposed taxonomy further breaks down this criterion into seven sub-criteria and 25 sub-categories.

Click [here](#) to view a detailed description and definition of ACTIVITIES category, criteria and sub-category.

PREPSOIL taxonomy categories: PARTICIPANTS

The third chapter of Mission Implementation criteria focusses on the “**participants**” that LLs and LHs in the Mission Soil context need engage and involve in the LL/LHs initiatives.

In alignment to the [quadruple helix model](#), the proposed taxonomy further breaks down this criterion into four sub-criteria and 16 sub-categories.

Click [here](#) to view a detailed description and definition of PARTICIPANTS category, criteria and sub-category.

Level 1 PARTICIPANTS			
Level 2 ACADEMIA		CITIZENS, CIVIL SOCIETY & USERS	
Level 3 University researchers and research institutes		NGOs	
Natural, social, behavioural sciences research		Citizen groups & communities	
		Local, regional and/or national movements	
		Tech-oriented solution providers	
		Engineers, specialists, and advisors	
		Manufacturers	
		Land managers and owners	
		Others	
		Soil analysts and environmental managers	
		Water and waste management	
		Policy makers	
		Authorities and regulators	
		Governmental organizations	
		Health authorities	
		Government & PUBLIC SECTOR	

PREPSOIL taxonomy categories: CONTEXT

Level 1 CONTEXT		
Level 2 PHYSICAL BOUNDARIES		POLICY AND GOVERNANCE
System context		
Level 3 Infrastructure: project level, LL level, network level		Internal organization
		Time frames
		Land and natural resource policies & directives
		Decision-making process
		Science-policy society interface
		Social values and norms
		Land and natural resource management
		Socio-economic context

The fourth chapter of Mission Implementation criteria focusses on the “**context**” that LLs and LHs in the Mission Soil context operate with and need to consider for the set up and implementation of their LL/LH.

The proposed taxonomy further breaks down this criterion into three sub-criteria and 9 sub-categories.

Click [here](#) to view a detailed description and definition of CONTEXT category, criteria and sub-category.



PREPSOIL taxonomy

To view high-resolution images please click:

- [Here](#) for the complete PREPSOIL taxonomy
- [Here](#) for the AIMS section
- [Here](#) for the ACTIVITIES section
- [Here](#) for the PARTICIPANTS section
- [Here](#) for the CONTEXT section

Using the PREPSOIL taxonomy criteria

The criteria of the PREPSOIL taxonomy should not be viewed as a rigid blueprint or a simple checklist. Instead, they should serve as guidelines for defining the LLs and LHs operational and strategic frameworks, as well as for the regular monitoring and evaluation for learning.

In setting up LL and LH, these criteria, which represent key characteristics of LLs and LHs in the Mission Soil context, should be integrated into and drive the co-design of the LL/LH strategy such as governance, stakeholder identification, implementation plan, business model plan, etc.

Alongside, each criterion acts as benchmark for evaluating current practices and identifying areas for improvement. LLs and LHs should employ these criteria for self-assessment and reflection, enabling them to assess their progress and effectiveness in soil health improvement. This involves a systematic review of each criterion, assessing how current practices align with the benchmarks, and identifying gap areas needing enhancement or higher attention.

Application and prioritization

Given the PREPSOIL set of criteria, LLs and LHs should adopt a strategic approach in their application and alignment.

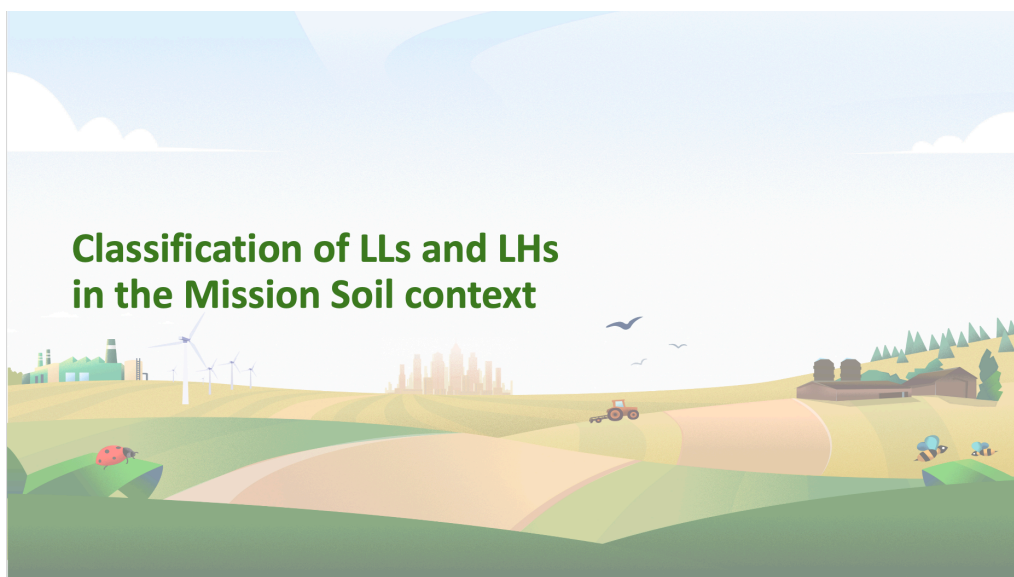
It is not necessary for all criteria to be met simultaneously. Instead, stakeholders should prioritize criteria based on their relevance and impact. The establishment of guiding thresholds or targets for each criterion tailored to the unique context of the LL can facilitate this process.

By prioritizing criteria and setting clear thresholds, LLs and LHs can focus on the most critical aspects first. This approach allows for a more manageable and effective implementation of strategies.

Additionally, setting milestones for progressively achieving compliance with all criteria helps promote a balanced and sustainable improvement in soil health. This structured and phased approach ensures that LLs and LHs can systematically address key areas while working towards comprehensive and long-term goals.

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Soil LLs and LHs classification

Considering the alignment to Mission Soil objectives, their adherence to the PREPSOIL taxonomy, and their stages of development, the LLs and LHs in the Mission Soil context can be classified along a three-level scale:

Mission Soil Living Labs and Lighthouses

The first category encompasses LLs and LHs that are specifically funded under the dedicated topics of the Mission Soil. These initiatives are fully compliant with the LL/LH criteria of the Mission Soil further defined in the PREPSOIL taxonomy.

European Soil Living Labs and Lighthouses

The second category includes LLs and LHs that exist within the broader European landscape that are fully aligned to the Mission Soil criteria and PREPSOIL taxonomy but do not receive direct funding from the dedicated Mission Soil topics.

Emerging Soil Living Labs and Lighthouses

The third category consists of potential and emerging LLs and LHs initiatives, including on-the-ground experiments and pilot projects, that have not yet fully aligned with the Mission Soil criteria and PREPSOIL taxonomy.

Process for Soil LLs and LHs classification

While the first category of Soil LLs and LHs is automatically defined by the award of grants under the dedicated Mission Soil topics, a process has been defined for the classification of other LLs and LHs initiatives [mapped by PREPSOIL](#) among category 2 (European Soil LLs & LHs) and category 3 (Emerging Soil LLs & LHs). Such process has been defined thanks to a close collaboration of the PREPSOIL and the [SOILL-Startup](#) project.

1. At first, the initiatives mapped and registered on the PREPSOIL map will be invited to complete the simplified [PREPSOIL self-assessment form](#).
2. Based on the provided answers, initiatives not aligned to the Mission Soil criteria will be categorised as “Emerging Soil LLs & LHs”. Those that comply with the minimum “invitation criteria”, will be invited to complete the in-depth SOILL self-assessment form.
3. Based on the results of the SOILL self-assessment form, initiatives will be either promoted to European Soil LLs & LHs or classified as “Emerging Soil LLs & LHs”.

PREPSOIL Self-assessment Form

Purpose

The PREPSOIL self-assessment form helps the identification of LL/LHs initiatives aligning to the Mission Soil criteria and PREPSOIL taxonomy, serving three main purposes:

1. Self-assessment and reflection for LL/LHs

By incorporating insights from the taxonomy, the form guides their approach and pinpoints areas for improvement, driving further development. This tool provides stakeholders with a comprehensive way to assess progress and uncover growth opportunities. It breaks down the taxonomy's key categories into straightforward questions for self-reflection.

Whether used in reviews, milestones, or ad-hoc assessments, it is designed to be versatile across various contexts.

2. Pre-classification of LL/LHs initiatives not directly funded under the dedicated Mission Soil topics

Through the identification of criteria based on the provided answers, the PREPSOIL self-assessment form will facilitate the distinction of LL/LHs initiatives not yet aligned to the Mission Soil criteria (Emerging Soil LLs and LHs, category 3) from those potentially aligned to such criteria and thus potentially identifiable as European Soil Living Labs and Lighthouses (category 2).

3. Identification of LL/LHs initiatives needs

Thanks to the mapping of areas needing further development for alignment to the PREPSOIL taxonomy, the results of the form will feed the identification of services and support needs of the PREPSOIL mapped initiative.

Overview

The self-assessment form is designed to complement and integrate with the [self-registration form](#) launched by PREPSOIL in June 2023, which records new LLs and LHs initiatives to feed the PREPSOIL [interactive atlas of LLs and LHs](#).

- The self-assessment form contains 29 questions for LHs and 23 questions for LLs/ES, including the 11 questions from the self-registration form.
- The questionnaire favours closed answers (either single or multiple choice) to ensure a simple user experience, limiting open answers to basic quantitative figures.



PREPSOIL self-registration form

To expand the [PREPSOIL interactive map](#), a [self-registration form](#) has been developed and integrated on the PREPSOIL website to identify additional initiatives to be included on the map.

Such form collects key details necessary for the integration on the online atlas such as initiative name, location, soil type focus (Agriculture, Forestry, Natural, Urban, Other), contact information, website, and description.

It also features automatic geolocation and allows linking "experimental sites" (ES) to main initiatives during registration.

QUESTION	TYPE	ANSWER
1. Type	Closed answer, single choice	<input type="checkbox"/> Living Lab (LL) <input type="checkbox"/> Lighthouse (LH) <input type="checkbox"/> Experimental Site (ES)
2. Full address	Open answer	
3. Name	Open answer	
4. Country where the LL/LH/ES is located	Open answer	
5. Contact person (full name)	Open answer	
6. Contact person direct email	Open answer	
7. Role of the contact person	Open answer	
8. General contact phone number	Open answer	
9. Website	Open answer	
10. Description (max 1000 characters)	Open answer	
11. Type of soil addressed (select all that apply)	Closed answer, multiple choice	<input type="checkbox"/> Agriculture <input type="checkbox"/> Forestry <input type="checkbox"/> Urban <input type="checkbox"/> Industry <input type="checkbox"/> Other... (specify)

PREPSOIL Self-assessment form: Living Labs (i)

QUESTION	TYPE	ANSWER	INVITATION CRITERIA*
1. How many experimental sites do you currently have?	Open answer, mandatory	[number]	N/A
2. How many do you target to reach?	Open answer, mandatory	[number]	>5; invited to SOILL-Startup
3. How many of these sites are already identified as LHs?	Open answer, mandatory	[number]	N/A
4. Do you have a target number of LHs? If yes, how many?	Open answer, mandatory	[number]	N/A
5. Which Mission Soil objectives (environmental impact indicators) will be addressed in your Living Lab? (Select all that apply)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Reduce desertification <input type="checkbox"/> Conserve soil organic carbon stocks <input type="checkbox"/> Stop soil sealing & increase re-use of urban soils <input type="checkbox"/> Reduce soil pollution and enhance restoration <input type="checkbox"/> Prevent erosion <input type="checkbox"/> Improve soil structure to enhance biodiversity <input type="checkbox"/> Reduce the EU global footprint on soils <input type="checkbox"/> Improve soil literacy in society <input type="checkbox"/> None of the above	= None of the above; invited
6. Is your LL operating or performing in real-life environments? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited

*Invitation criteria refers to the type of result that the respondent needs to achieve to be invited to follow the SOILL-Startup assessment and monitoring. Within this column the questions that contain "N/A" refer to those that are not assessed

PREPSOIL Self-assessment form: Living Labs (ii)

QUESTION	TYPE	ANSWER	INVITATION CRITERIA*
7. Which different types of stakeholder groups of the quadruple helix are present in the ecosystem of your Living Lab? (Select all that apply)	Closed answer, multiple choice, mandatory	Academia <input type="checkbox"/> Universities <input type="checkbox"/> Research institutions <input type="checkbox"/> Agricultural schools <input type="checkbox"/> Other schools <input type="checkbox"/> Vocational training centres <input type="checkbox"/> Science communication centres <input type="checkbox"/> Students Government & Public sector <input type="checkbox"/> Local authorities <input type="checkbox"/> Regional authorities <input type="checkbox"/> National authorities <input type="checkbox"/> International authorities <input type="checkbox"/> International networks (e.g. AKIS, EIP-AGRI) <input type="checkbox"/> (Environment) agencies <input type="checkbox"/> National Contact Points (NCPs) <input type="checkbox"/> Research funding organizations Industry <input type="checkbox"/> Land users <input type="checkbox"/> Land tenants <input type="checkbox"/> Land developers <input type="checkbox"/> Farming associations <input type="checkbox"/> Farming production organisations <input type="checkbox"/> Agri-food sector companies <input type="checkbox"/> Forest companies <input type="checkbox"/> Forest owner associations <input type="checkbox"/> Construction sector companies <input type="checkbox"/> Tourism organizations <input type="checkbox"/> Service providers <input type="checkbox"/> Lobby groups Citizens, Civil society & Users <input type="checkbox"/> NGOs <input type="checkbox"/> Communities of citizens <input type="checkbox"/> Community centres <input type="checkbox"/> Kindergartens <input type="checkbox"/> Youth organizations <input type="checkbox"/> Artists & designers <input type="checkbox"/> Citizen scientists (communities) <input type="checkbox"/> Other, namely: _____ <input type="checkbox"/> None of the above	At least one answer for each block; invited

*Invitation criteria refers to the type of result that the respondent needs to achieve to be invited to follow the SOILL-Startup assessment and monitoring. Within this column the questions that contain "N/A" refer to those that are not assessed



PREPSOIL Self-assessment form: Living Labs (iii)

QUESTION	TYPE	ANSWER	INVITATION CRITERIA*
8. Are you applying multi-actor approach in your daily LL activities and strategy definition? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited
9. Are you co-creating your LL strategies and projects? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, but planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited
10. Is your LL regularly organizing co-creation activities? (select one)	Closed answer, single choice	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, but planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited
11. Do you have a governance of you LL? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, but planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited
12. Which of the quadruple helix are involved in the governance of your LL?	Closed answer, multiple choice. Only if answer above is "Yes" or "Not yet, but planned for".	<input type="checkbox"/> Academia <input type="checkbox"/> Government & Public sector <input type="checkbox"/> Citizens, civil society & users <input type="checkbox"/> Industry & private sector <input type="checkbox"/> None of the above	N/A
13. Do you have long-term stability strategies for your LL? (select one)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, but planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited

*Invitation criteria refers to the type of result that the respondent needs to achieve to be invited to follow the SOILL-Startup assessment and monitoring. Within this column the questions that contain "N/A" refer to those that are not assessed

PREPSOIL Self-assessment form: Living Labs (iv)

QUESTION	TYPE	ANSWER	INVITATION CRITERIA*
14. Is your LL developed in the context of a public-funded project? (select one)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No	N/A
15. What is the acronym and title of the project?	Open answer, mandatory only if answer 14 is "Yes".		N/A
16. What is the funding programme?	Open answer, mandatory only if answer 14 is "Yes".		N/A
17. What is the contract or the GA number?	Open answer, mandatory only if answer 14 is "Yes".		N/A
18. Please insert here the project website if available	Open answer only if answer 14 is "Yes".		N/A

*Invitation criteria refers to the type of result that the respondent needs to achieve to be invited to follow the SOILL-Startup assessment and monitoring. Within this column the questions that contain "N/A" refer to those that are not assessed

PREPSOIL Self-assessment form: Lighthouses/sites (i)

QUESTION	TYPE	ANSWER	INVITATION CRITERIA*
1. Which Mission Soil objectives (environmental impact indicators) will be addressed in your Soil Health Lighthouse/experimental site? (Select all that apply)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Reduce desertification <input type="checkbox"/> Conserve soil organic carbon stocks <input type="checkbox"/> Stop soil sealing & increase re-use of urban soils <input type="checkbox"/> Reduce soil pollution and enhance restoration <input type="checkbox"/> Prevent erosion <input type="checkbox"/> Improve soil structure to enhance biodiversity <input type="checkbox"/> Reduce the EU global footprint on soils <input type="checkbox"/> Improve soil literacy in society <input type="checkbox"/> None of the above	≠ None of the above; invited
2. Is your Lighthouse/site operating or performing in real-life environments? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited

*Invitation criteria refers to the type of result that the respondent needs to achieve to be invited to follow the SOILL-Startup assessment and monitoring. Within this column the questions that contain "N/A" refer to those that are not assessed



PREPSOIL Self-assessment form: Lighthouses/sites(ii)

QUESTION	TYPE	ANSWER		INVITATION CRITERIA*
3. Which different types of stakeholder groups of the quadruple helix are present in the ecosystem of your Lighthouse/site? (Select all that apply)	Closed answer, multiple choice, mandatory	Academia <input type="checkbox"/> Universities <input type="checkbox"/> Research institutions <input type="checkbox"/> Agricultural schools <input type="checkbox"/> Other schools <input type="checkbox"/> Vocational training centres <input type="checkbox"/> Science communication centres <input type="checkbox"/> Students Government & Public sector <input type="checkbox"/> Local authorities <input type="checkbox"/> Regional authorities <input type="checkbox"/> National authorities <input type="checkbox"/> International authorities <input type="checkbox"/> International networks (e.g. AKIS, EIP-AGRI) <input type="checkbox"/> (Environment) agencies <input type="checkbox"/> National Contact Points (NCPs) <input type="checkbox"/> Research funding organizations	Industry <input type="checkbox"/> Land users <input type="checkbox"/> Land tenants <input type="checkbox"/> Land developers <input type="checkbox"/> Farming associations <input type="checkbox"/> Farming production organisations <input type="checkbox"/> Agri-food sector companies <input type="checkbox"/> Forest companies <input type="checkbox"/> Forest owner associations <input type="checkbox"/> Construction sector companies <input type="checkbox"/> Tourism organizations <input type="checkbox"/> Service providers <input type="checkbox"/> Lobby groups Citizens, Civil society & Users <input type="checkbox"/> NGOs <input type="checkbox"/> Communities of citizens <input type="checkbox"/> Community centres <input type="checkbox"/> Kindergartens <input type="checkbox"/> Youth organizations <input type="checkbox"/> Artists & designers <input type="checkbox"/> Citizen scientists (communities) <input type="checkbox"/> Other, namely: _____ <input type="checkbox"/> None of the above	At least one answer for each block; invited

*Invitation criteria refers to the type of result that the respondent needs to achieve to be invited to follow the SOILL-Startup assessment and monitoring. Within this column the questions that contain "N/A" refer to those that are not assessed

PREPSOIL Self-assessment form: Lighthouses/sites (iii)

QUESTION	TYPE	ANSWER	INVITATION CRITERIA*
4. Are you developing, or did you develop land use systems that satisfy criteria for sustainable development, in terms of soil health and related ecosystem services? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited
5. Do you carry out demonstration to soil managers, the public and the policy arena? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited
6. Do you carry out dissemination and promotion to soil managers, the public and the policy arena? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited
7. Are you collaborating with the policy arena for science-based policy support and governance? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited

*Invitation criteria refers to the type of result that the respondent needs to achieve to be invited to follow the SOILL-Startup assessment and monitoring. Within this column the questions that contain "N/A" refer to those that are not assessed

PREPSOIL Self-assessment form: Lighthouses/sites(iv)

QUESTION	TYPE	ANSWER	INVITATION CRITERIA*
8. Is your LH/site developed in the context of a public-funded project? (select one)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No	N/A
9. What is the acronym and title of the project?	Open answer, mandatory only if answer 8 is "Yes".		N/A
10. What is the funding programme?	Open answer, mandatory only if answer 8 is "Yes".		N/A
11. What is the contract or the GA number?	Open answer, mandatory only if answer 8 is "Yes".		N/A
12. Please insert here the project website	Open answer, only if answer 8 is "Yes".		N/A

*Invitation criteria refers to the type of result that the respondent needs to achieve to be invited to follow the SOILL-Startup assessment and monitoring. Within this column the questions that contain "N/A" refer to those that are not assessed



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The banner features a colorful illustration of a rural landscape with rolling hills, a tractor, wind turbines, and a city skyline in the distance.



ANNEX 2. Self-assessment tool

The following tables are designed to streamline the self-assessment process by drawing on the outputs of this deliverable.

Table 2.1 outlines the questions included in the current registration form for the map¹⁶, which have already been collected for mapped initiatives. This is provided to illustrate the type of information gathered and to prevent redundancy in the self-assessment tool.

Moreover, this annex includes the self-assessment questionnaire for LLs (Table 2.2) and LHs (Table 2.3). This questionnaire aims to enhance user experience by providing a simpler, more streamlined format.

Each table presents the questions, their type (open, closed, or multiple-choice), and the available options. Furthermore, the last column “invitation criteria” refers to the type of result that the respondent needs to achieve to be invited to follow the SOILL-Startup assessment and monitoring. Within this column the questions that contain “N/A” refer to those that are not assessed.

Moreover, the data transfer, General Data Protection Regulation (GDPR) compliance, exploitation plan and compliance with the GA provisions are under discussion among partners of PREPSOIL and SOILL-Startup.

Table 2.1. PREPSOIL map self-registration form

QUESTION	TYPE	SELECTION
1. Type	Closed answer, single choice	<input type="checkbox"/> Living Lab (LL) <input type="checkbox"/> Lighthouse (LH) <input type="checkbox"/> Experimental Site (ES)
2. Full address	Open answer	
3. Name	Open answer	
4. Country where the LL/LH/ES is located	Open answer	
5. Contact person (full name)	Open answer	
6. Contact person direct email	Open answer	
7. Role of the contact person	Open answer	
8. General contact phone number	Open answer	
9. Website	Open answer	
10. Description (max 1000 characters)	Open answer	
11. Type of soil addressed (select all that apply)	Closed answer, multiple choice	<input type="checkbox"/> Agriculture <input type="checkbox"/> Forestry <input type="checkbox"/> Urban <input type="checkbox"/> Industry

¹⁶ <https://prepsoil.eu/prepsoil-map-self-registration-form>



		<input type="checkbox"/> Other... [specify]
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Table 2.2. PREPSOIL self-assessment questions for LLs

QUESTION	TYPE	SELECTION	INVITATION CRITERIA
1. How many experimental sites do you currently have?	Open answer, mandatory	[number]	N/A
2. How many do you target to reach?	Open answer, mandatory	[number]	>5; invited to SOILL-Startup
3. How many of these sites are already identified as LHs?	Open answer, mandatory	[number]	N/A
4. Do you have a target number of LHs? If yes, how many?	Open answer, mandatory	[number]	N/A
5. Which Mission Soil objectives (environmental impact indicators) will be addressed in your Living Lab? (Select all that apply)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Reduce desertification <input type="checkbox"/> Conserve soil organic carbon stocks <input type="checkbox"/> Stop soil sealing & increase re-use of urban soils <input type="checkbox"/> Reduce soil pollution and enhance restoration <input type="checkbox"/> Prevent erosion <input type="checkbox"/> Improve soil structure to enhance biodiversity <input type="checkbox"/> Reduce the EU global footprint on soils <input type="checkbox"/> Improve soil literacy in society <input type="checkbox"/> None of the above	≠ None of the above; invited
6. Is your LL operating or performing in real-life environments? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited
7. Which different types of stakeholder groups of the quadruple helix are present in the ecosystem of your Living Lab? (Select all that apply)	Closed answer, multiple choice, mandatory	Academia <input type="checkbox"/> Universities <input type="checkbox"/> Research institutions <input type="checkbox"/> Agricultural schools <input type="checkbox"/> Other schools <input type="checkbox"/> Vocational training centres <input type="checkbox"/> Science communication centres <input type="checkbox"/> Students Government & Public sector <input type="checkbox"/> Local authorities <input type="checkbox"/> Regional authorities <input type="checkbox"/> National authorities	At least one answer for each block; invited



QUESTION	TYPE	SELECTION	INVITATION CRITERIA
		<input type="checkbox"/> International authorities <input type="checkbox"/> International networks (e.g. AKIS, EIP-AGRI) <input type="checkbox"/> (Environment) agencies <input type="checkbox"/> National Contact Points (NCPs) <input type="checkbox"/> Research funding organizations Industry <input type="checkbox"/> Land users <input type="checkbox"/> Land tenants <input type="checkbox"/> Land developers <input type="checkbox"/> Farming associations <input type="checkbox"/> Farming production organisations <input type="checkbox"/> Agri-food sector companies <input type="checkbox"/> Forest companies <input type="checkbox"/> Forest owner associations <input type="checkbox"/> Construction sector companies <input type="checkbox"/> Tourism organizations <input type="checkbox"/> Service providers <input type="checkbox"/> Lobby groups Citizens, Civil society & Users <input type="checkbox"/> NGOs <input type="checkbox"/> Communities of citizens <input type="checkbox"/> Community centres <input type="checkbox"/> Kindergartens <input type="checkbox"/> Youth organizations <input type="checkbox"/> Artists & designers <input type="checkbox"/> Citizen scientists (communities) <input type="checkbox"/> Other, namely: <input type="checkbox"/> None of the above	
8. Are you applying multi-actor approach in your daily LL activities and strategy definition? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited
9. Are you co-creating your LL strategies and projects? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, but planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited



QUESTION	TYPE	SELECTION	INVITATION CRITERIA
10. Is your LL regularly organizing co-creation activities? (select one)	Closed answer, single choice	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, but planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited
11. Do you have a governance of you LL? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, but planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited
12. Which of the quadruple helix are involved in the governance of your LL?	Closed answer, multiple choice. Only if answer above is "Yes" or "Not yet, but planned for".	<input type="checkbox"/> Academia <input type="checkbox"/> Government & Public sector <input type="checkbox"/> Citizens, civil society & users <input type="checkbox"/> Industry & private sector <input type="checkbox"/> None of the above	N/A
13. Do you have long-term stability strategies for your LL? (select one)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> Not yet, but planned for <input type="checkbox"/> No <input type="checkbox"/> I don't know	= Yes OR Not yet; invited
14. Is your LL developed in the context of a public-funded project? (select one)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No	N/A
15. What is the acronym and title of the project?	Open answer, mandatory only if answer 14 is "Yes".		N/A
16. What is the funding programme?	Open answer, mandatory only if answer 14 is "Yes".		N/A
17. What is the contract or the GA number?	Open answer, mandatory only if answer 14 is "Yes".		N/A
18. Please insert here the project website if available	Open answer only if answer 14 is "Yes".		N/A

Table 2.3. PREPSOIL self-assessment questions for LHs/experimental sites.



QUESTION	TYPE	SELECTION	INVITATION CRITERIA
1. Which Mission Soil objectives (environmental impact indicators) will be addressed in your Soil Health Lighthouse/experimental site? (Select all that apply)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Reduce desertification <input type="checkbox"/> Conserve soil organic carbon stocks <input type="checkbox"/> Stop soil sealing & increase re-use of urban soils <input type="checkbox"/> Reduce soil pollution and enhance restoration <input type="checkbox"/> Prevent erosion <input type="checkbox"/> Improve soil structure to enhance biodiversity <input type="checkbox"/> Reduce the EU global footprint on soils <input type="checkbox"/> Improve soil literacy in society <input type="checkbox"/> None of the above	≠ None of the above; invited
2. Is your Lighthouse/site operating or performing in real-life environments? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited
3. Which different types of stakeholder groups of the quadruple helix are present in the ecosystem of your Lighthouse/site? (Select all that apply)	Closed answer, multiple choice, mandatory	Academia <input type="checkbox"/> Universities <input type="checkbox"/> Research institutions <input type="checkbox"/> Agricultural schools <input type="checkbox"/> Other schools <input type="checkbox"/> Vocational training centres <input type="checkbox"/> Science communication centres <input type="checkbox"/> Students Government & Public sector <input type="checkbox"/> Local authorities <input type="checkbox"/> Regional authorities <input type="checkbox"/> National authorities <input type="checkbox"/> International authorities <input type="checkbox"/> International networks (e.g. AKIS, EIP-AGRI) <input type="checkbox"/> (Environment) agencies <input type="checkbox"/> NCPs <input type="checkbox"/> Research funding organizations Industry	At least one answer for each block; invited



QUESTION	TYPE	SELECTION	INVITATION CRITERIA
		<input type="checkbox"/> Land users <input type="checkbox"/> Land tenants <input type="checkbox"/> Land developers <input type="checkbox"/> Farming associations <input type="checkbox"/> Farming production organisations <input type="checkbox"/> Agri-food sector companies <input type="checkbox"/> Forest companies <input type="checkbox"/> Forest owner associations <input type="checkbox"/> Construction sector companies <input type="checkbox"/> Tourism organizations <input type="checkbox"/> Service providers <input type="checkbox"/> Lobby groups Citizens, Civil society & Users <input type="checkbox"/> NGOs <input type="checkbox"/> Communities of citizens <input type="checkbox"/> Community centres <input type="checkbox"/> Kindergartens <input type="checkbox"/> Youth organizations <input type="checkbox"/> Artists & designers <input type="checkbox"/> Citizen scientists (communities) <input type="checkbox"/> Other, namely: <input type="checkbox"/> None of the above	
4. Are you developing, or did you develop land use systems that satisfy criteria for sustainable development, in terms of soil health and related ecosystem services? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited
5. Do you carry out demonstration to soil managers, the public and the policy arena? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited
6. Do you carry out dissemination and promotion to soil managers, the public and	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially	= Yes OR Partially; invited



QUESTION	TYPE	SELECTION	INVITATION CRITERIA
the policy arena? (select one)		<input type="checkbox"/> I don't know	
7. Are you collaborating with the policy arena for science-based policy support and governance? (select one)	Closed answer, single choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> I don't know	= Yes OR Partially; invited
8. Is your LH/site developed in the context of a public-funded project? (select one)	Closed answer, multiple choice, mandatory	<input type="checkbox"/> Yes <input type="checkbox"/> No	N/A
9. What is the acronym and title of the project?	Open answer, mandatory only if answer 8 is "Yes".		N/A
10. What is the funding programme?	Open answer, mandatory only if answer 8 is "Yes".		N/A
11. What is the contract or the GA number?	Open answer, mandatory only if answer 8 is "Yes".		N/A
12. Please insert here the project website	Open answer, only if answer 8 is "Yes".		N/A



ANNEX 3. Soil Mission criteria

Criteria for the selection and set-up of Living Labs and lighthouses (Source: Soil Implementation Plan).

Type of criteria	Description
Aims	<ul style="list-style-type: none"> • Innovation and co-creation. • Formal learning. • Contributing to societal challenges, sustainability, and resilience. • Improving soil health and ecosystem services, thereby achieving the soil mission objectives in a holistic manner (minimising trade-offs) in the specific context of the region in which it operates.
Activities	<ul style="list-style-type: none"> • Outreach and facilitation of engagement of the land users. • Co-design/co-development/co-creation of innovations focused on improving soil health and ecosystem services, in major soils and land use systems in a given region/area. • Experimentation of innovative practices and solutions using transdisciplinary, multiactor, systems approaches, in real-life settings, seeking to adapt scientifically proven solutions to local conditions (on real farms, forest exploitation or urban soil management sites). • Measurement/monitoring/evaluation of impact of innovative practices/approaches on soil health and related ecosystem services at site and landscape levels, involving research and innovative measurement technologies (data management, sensing, monitoring, assessment modelling). • Evaluation of socio-economic impacts and behavioural drivers and lock-ins related to the adoption of the innovations by soil managers. • Contributing to networking and knowledge exchange with other sites/LL/LH & EIP-AGRI. • Testing, validating and improving the comprehensive soil and ecosystem monitoring system through co-creation (including assessment, training and education on tools). • For sites that have reached a high level of performance (lighthouses): • Demonstration, dissemination and promotion to soil managers, the public and the policy arena, at landscape scale and beyond, of land use systems that satisfy criteria for sustainable development, in particular in terms of soil health and related ecosystem services. • Reaching out to the policy arena linking results of the LHs to environmental rules and regulations. This in line with science-based policy support and governance.
Participants	<ul style="list-style-type: none"> • Public-private-people partnership involving if possible four groups: science, policy, practice, citizens.



	<ul style="list-style-type: none"> • Active engagement in co-development and experimentation of the multiplicity of users having an impact on the achievement of the societal goals. • Users of primary importance to achieve the soil mission objectives: soil managers (farmers, advisors, foresters, city greens managers, allotment holder, industries with impacts on soils etc.) and researchers. They would have the responsibility early in the process to connect with other interests such as: associations and organisations with an interest in soil health and related ecosystem services, local or regional government, scientists from a variety of fields outside soils (natural sciences, social and behavioural sciences etc.). The list of users may depend on the specificities of the places and challenges that are specific to that place. • For demonstration activities: target audiences include soil managers, the public arena and relevant networks such as for example EIP-AGRI.
Context	<ul style="list-style-type: none"> • Transdisciplinary and participatory approach. • Multi-method approach. • Place-based; well defined system boundaries (e.g. farm, (sub)-watershed, neighbourhood, NUTS region, value chain) of relevance to soil challenges. This relates to specific regions and sectors. • Real-life context = real farms/forest or urban/industrial sites, seeking to go beyond current practice. • Long-term set-up. • Openness, communication and dissemination and connection with networks. • Multiple dimensions: technical, economic, social. • Robust scientific set-up for ecosystem assessment.



ANNEX 4. Related milestone reports

MS5 Guidelines for mapping LLs/LHs



Preparing for the ‘Soil deal for Europe’ Mission

Project number: 101070045

Milestone 5

Guidelines for mapping LLs/LHs

Title	Guidelines for mapping LLs/LHs
Work package no:	4
Milestones no:	5
Milestones description:	This document describes the creation of the PREPSOIL Living Labs and Lighthouses map, emphasizing the action plan and delineating the criteria for updating and categorizing the Soil Health initiatives.
Due date:	January 2024 (M19)
Submission date:	31 January 2024
Authors:	Dolinda Cavallo, Mar Ylla Gelabert
Version:	2

Project acronym:	PREPSOIL
Project name:	Preparing for the ‘Soil Deal for Europe’ Mission
Project number:	101070045
Call topic:	HORIZON-MISS-2021-SOIL-01-01
Type of action:	HORIZON-CSA

Milestone 6 - Material and prototype for virtual LL/LH interactive maps ready

Abbreviations

EU	European Union
KPI	Key performance indicator
LHs	Lighthouses
LLs	Living Labs
M	Month
MS	Milestone
O5	Objective 5
SHLHs	Soil Health Lighthouses
SHLLs	Soil Health Living Labs
SMS	Soil Mission Support
T	Task
WP4	Work package 4

Introduction

The Mission "A Soil Deal for Europe" – hereafter referred to as Soil Mission - aims to establish 100 Living Labs (LLs) and Lighthouses (LHs) by 2030, leading the transition toward healthy soils. Recognizing the vital role of soil in sustaining life on Earth, the mission underscores its significance in supporting food systems, clean water, biodiversity, and climate resilience. It emphasizes the need to address the lack of awareness among various stakeholders, such as land managers, industries, consumers, and society, as a key driver of soil degradation, impacting its ability to provide essential ecosystem services. According to the implementation plan of the Soil Mission¹⁷, soil health living labs and lighthouses are defined as:

"Soil health living labs" (SHLLs) are defined as "user-centred, place-based and transdisciplinary research and innovation ecosystems, which involve land managers, scientists and other relevant partners in systemic research and codesign, testing, monitoring and evaluation of solutions, in real-life settings, to improve their effectiveness for soil health and accelerate adoption." These living labs are collaborations between multiple partners that operate at regional or sub-regional level and coordinate experiments on several sites within a regional or sub-regional area (or working landscapes);

"Lighthouses" (LHs) are defined as "places for demonstration of solutions, training and communication that are exemplary in their performance in terms of soil health improvement". They are local sites (one farm, one forest exploitation, one industrial site, one urban city green area, etc.) that can be included in a living lab area or be situated outside a living lab area.

The PREPSOIL (Preparing for the "Soil Deal for Europe" Mission) project aims to facilitate the Soil Mission's implementation across European regions. This involves the collaborative development and implementation of tools and platforms for interaction, knowledge-sharing, and co-learning. Additionally, the project includes stocktaking and dialogue to comprehend how a regional assessment of soil needs, supported by standardized monitoring mechanisms, can translate into action within living labs and exemplary projects focused on promoting soil health.

As part of Work Package (WP) 4 led by the European Network of Living Labs (ENoLL), which centres on "Knowledge transfer and co-creation in regional Living Labs," Task (T) 4.2 focuses on the "Identification and mapping of Living Labs and Lighthouses". The objective of T4.2 is to map current and emerging LLs and LHs and to engage developing/emerging LLs. ENoLL leads T4.2, drawing insights from the outcomes of T4.1 and WP2 on maturity level of LLs and LHs with different soil use types and socio-economic context towards the designing of taxonomy for different LL/LH types.

This report describes the guidelines for mapping LLs and LHs to demonstrate the achievement of the milestone (MS) 5. Based on the mission implementation plan criteria for LLs, the following report outlines the principles for updating and categorising the LLs and LHs that are represented on the PREPSOIL map.

In alignment with the project's objective 5 (O5) and the key performance indicator (KPI) to "map and reach out to +150 LL/LHs and the launch of an interactive map in the web portal by month (M) 24" (WP3&4), the mapping process aims to promote networking and knowledge exchange among LLs and LHs. Furthermore, the mapping process is planned to build upon and to integrate information from previous inventories, specifically from the SMS project, CSAs, All-Ready, and AE4EU.

The synthesized data resulting from this effort will be utilized in T4.2, allowing for visualization in an interactive virtual atlas accessible through the PREPSOIL webpage. The goal is to facilitate enhanced

¹⁷ Soil Mission Implementation Plan. https://research-and-innovation.ec.europa.eu/system/files/2021-09/soil_mission_implementation_plan_final_for_publication.pdf

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collaboration and knowledge exchange within similar ecosystems across Europe. The subsequent sections provide a detailed overview of the steps involved in mapping these LLs/LHs.

Terminology

In this context, LLs and LHs shown on the map are referred to as “initiatives” or “potential LLs/LHs”. This terminology implies that these initiatives are candidates for funding from the EU. This change means that the initiatives have the potential to be funded by the EU. Those initiatives that successfully secure funding are specifically identified as “Soil Health Living Labs (SHLLs)” and “Soil Health Lighthouses (SHLHs)”.

The origins of the PREPSOIL map

The PREPSOIL map was built on the Soil Mission Support (SMS) (GA 101000258, 2020-2022)¹⁸ project which aimed to improve the coordination of research and innovation (R&I) on sustainable soil and land management in Europe. The SMS project launched a knowledge platform that included an interactive map of potential living labs and light houses all over Europe known as “initiatives”. The following describes the map development process by SMS.

The SMS project started mapping potential LLs and LHs, in this document understood as initiatives, as part of T4.2. The project started by listing 91 initiatives previously identified by the (at that time named) “European Mission Board for Soil Health and Food” (version Dec 2020). As a next step, different projects were reached out to contribute to the identification of LLs and LHs related to soil health by direct approach, such as different soil related R&I projects under the Horizon 2020 programme, European Innovation Partnership “Agricultural productivity and sustainability”, other projects and networks which concern aspects of sustainable soil management and improve and protect soil health. In addition, internet and literature search on LLs, LHs, and long-term observatories. This initial search added another 25 initiatives to the list of the Mission Board (SMS deliverable 2.2, 2021). The majority of the potential LLs & LHs in this list were on agricultural land use (94). For both forestry and (peri-)urban land, 11 potential LLs & LHs were listed. At this stage, it was not possible to divide between LL and LH and therefore some initiatives were listed as “LL/LH”. The list also contained 5 examples of LLs & LHs from beyond Europe. In the next step, effort was made to add potential LLs & LHs covering different land uses to the list and obtain a better coverage of Europe. Where possible, a division between LLs and LHs was made (and otherwise they remained listed as LL/LH). An effort was made to identify the location of these initiatives with the intention visualize the potential LLs & LHs on a map.

Although the SMS project lacked time or budget to validate all LLs & LHs, a first categorization of the list was made. For example, soil literacy initiatives, soil networks, Communities of Practice and farmer advice activities were also found in the initial overview and identified.

Finally, the list contained 241 entries (version September 2021). In the figures below the land use and geographical coverage can be seen (SMS deliverable 3.4, 2022).

¹⁸ Soil Mission Support. <https://cordis.europa.eu/project/id/101000258>

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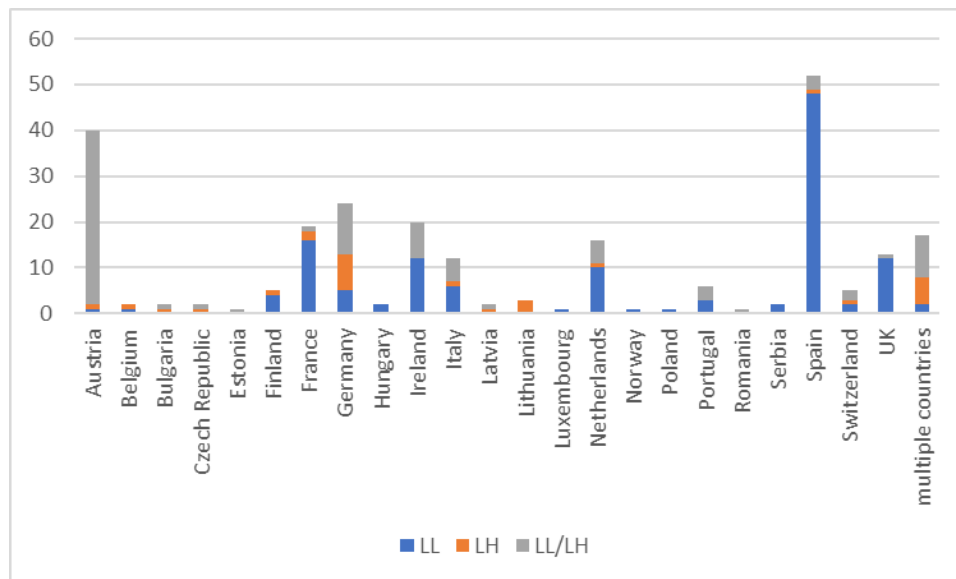


Figure1. LL, LH, LL/LH initiatives per country (only European)

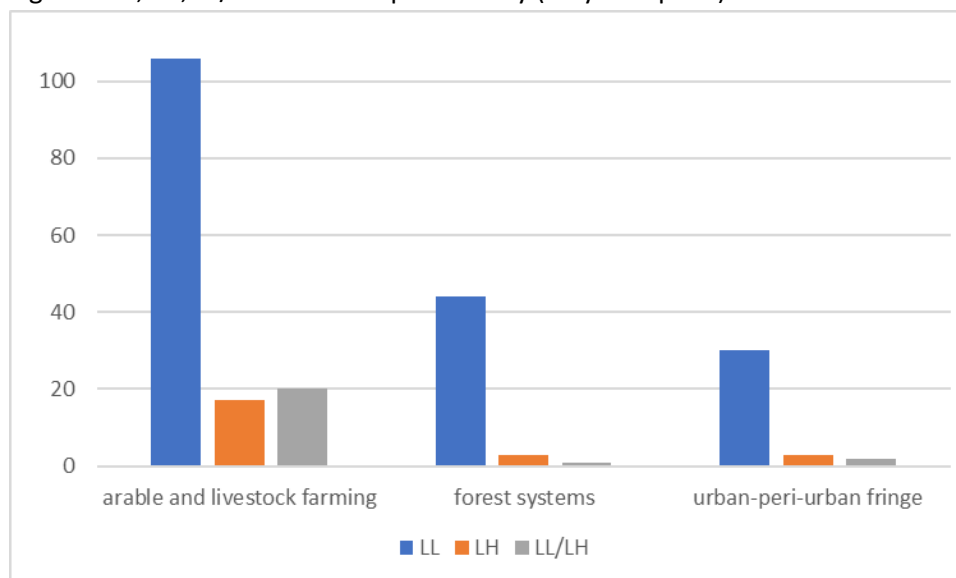


Figure 2. LL, LH, LL/LH initiatives per land use group (note that LL & LH that have no specified land use group are missing from this table)

The criteria to qualify as LL or LH was elaborated in the 3.4 deliverable of SMS and according to the implementation plan of the Soil Mission. While the entries were not validated, there were still a lot in the final SMS list of LLs & LHs that probably did not fulfil the criteria to qualify as a LL or LH. For example, many of the mapped LLs did not follow the landscape approach (not multiple sites within a LL) as in many cases the initiatives in the list consist of a single site or were not place-based at all. Like the above-mentioned soil literacy initiatives, such as Communities of Practice, Soil Networks, education programmes.

This exercise served to provide the Soil Mission a basis of what kind of (potential) LLs and LHs are already present and to identify gaps regarding which are missing in terms of regions, soils, climatic zones, land uses (agricultural, forestry, urban, etc.), soil needs, Soil Mission objectives.

Map configuration

Originating from the data provided by the SMS project, the PREPSOIL map serves as a tool to display soil health initiatives. The following section describes how the current visualization of the map is structured. This includes a synthesis of the data collected from both the SMS project and PREPSOIL, prior to implementing any updates.

The current map version¹⁹ enables users to filter by LLs and LHs. These filters correspond to various land uses such as agriculture, forest, urban development, and others, distinguishing between infrastructure and protected areas. Additionally, to highlight participating organizations from the previous SMS project, an extra filter distinguishes between those LLs and LHs identified by the SMS project and PREPSOIL. Moreover, organizations are marked with different pins based on their types, such as LL, LH, combined LL and LH initiatives, LL centres, and EU-funded projects.

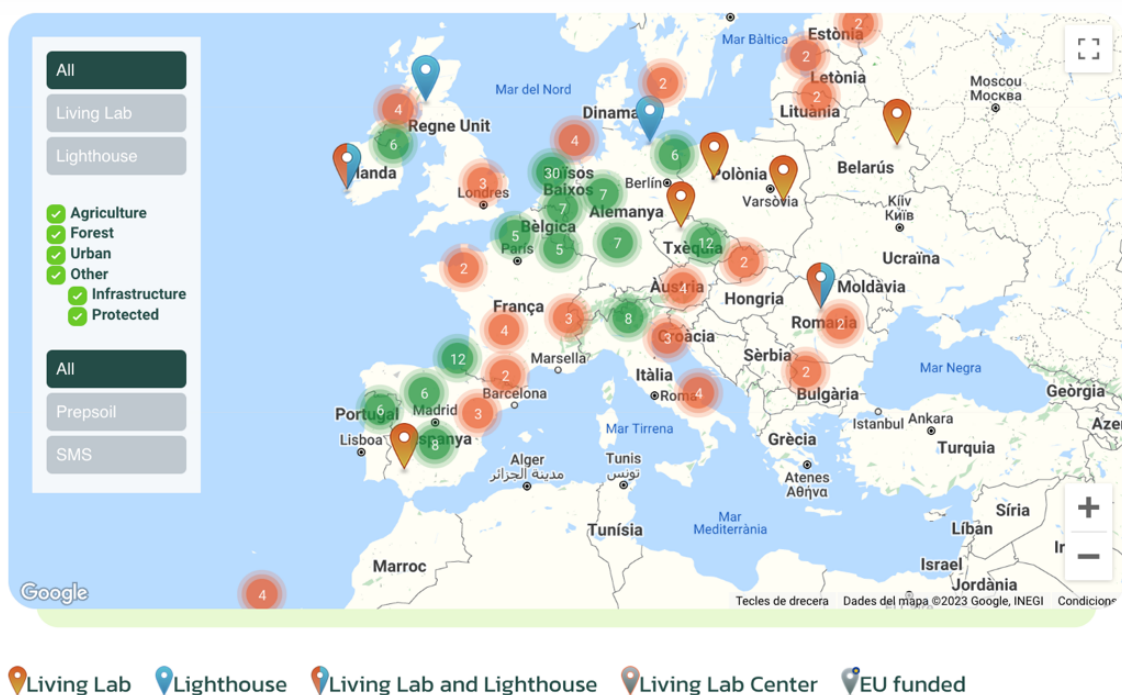


Figure 3. Current map configuration

Roadmap to PREPSOIL map of LLs and LHs

Introduction

T4.2 aims to engage and map regional LLs and LLs/LHs sites of relevance for the Mission by M24 (June 2024). This relates to O5, which seeks to comprehensively map current and emerging LLs and LHs to facilitate networking and knowledge exchange. The final aim is to visually represent +150 Soil Health Living Labs (SHLLs) and LHs as outlined by the Key Performance Indicator (KPI), that is EU funded LLs/LHs. Consequently, the updated map will not only feature EU-funded SHLLs but also incorporate all pertinent experimentation sites and LHs. This strategic approach enhances the visibility and comprehension of the collaborative network within the PREPSOIL project.

¹⁹ Map of Living Labs and Lighthouses. PREPSOIL. <https://prepsoil.eu/living-labs-and-lighthouses/map>

Methodology

Given PREPSOIL's objective of mapping soil health regional LLs and LLs/LHs across Europe, PREPSOIL's consortium recognized the imperative task of validating SMS' mapped data as well as contribute with new information acquired through the implementation of PREPSOIL. To achieve this, a well-structured roadmap comprising several steps has been developed.

The following figure displays the steps designed to reach the new version of the PREPSOIL map for the potential SHLLs & LHs. These are: revising, understanding, cleaning, and re-mapping. To ensure the realization of such stages, ENoLL met with the task participants involved in T4.2 once-a-month approximately to monitor the process of updating the map.

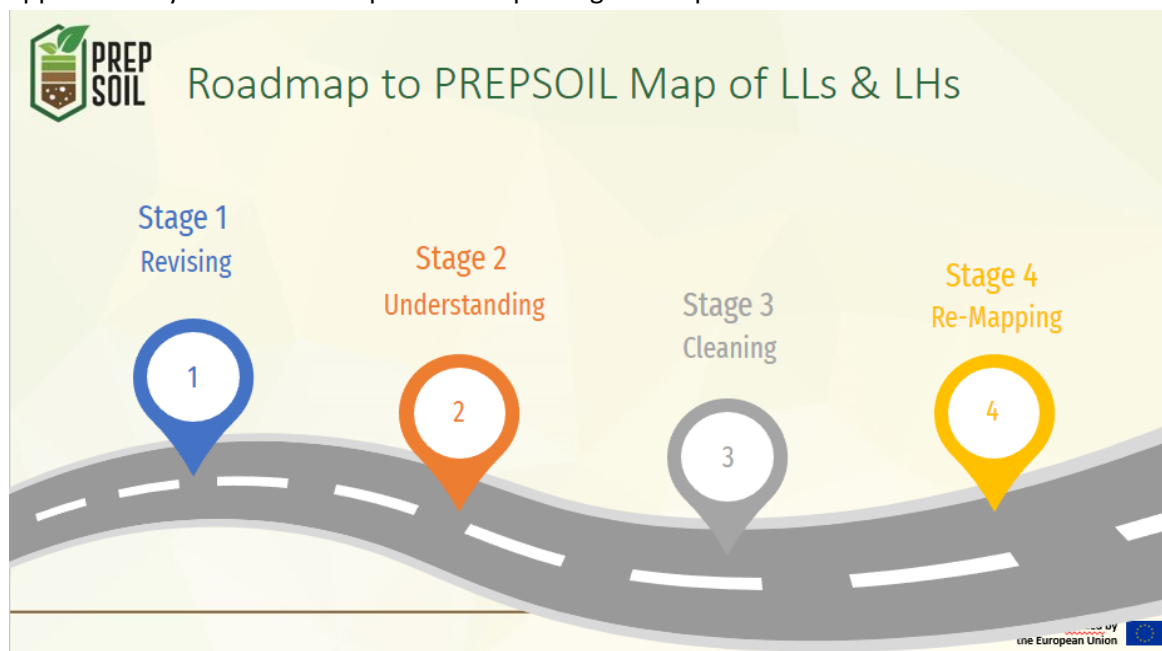


Figure 4. Steps to PREPSOIL Map of LLs and LHs

Stage 1: Revising

During this stage, the primary objective was to review and update the information on the map webpage. Thus, a new version of the PREPSOIL map text description and disclaimer was developed and subsequently approved. Moreover, during the revision of the map visualization, key decisions were made in collaboration with T4.2 partners and the project officer:

To prevent any misunderstanding, a consensus was reached to designate the LLs and LHs shown on the map as "initiatives" or "potential LLs/LHs". This terminology implies that these initiatives are candidates for funding from the EU. This change means that the initiatives have the potential to be funded by the EU. Those initiatives that successfully secure funding are specifically identified as "Soil Health Living Labs (SHLLs)" and "Soil Health Lighthouses (SHLHs)".

It was determined that, at a later stage, the SHLLs and LHs funded under the Soil Mission would be showcased as "SHLLs" and SHLHs once the information becomes publicly accessible and given that they fulfil the set of criteria defined by the implementation plan of the Soil Mission²⁰

The decision was made to eliminate the "EU funded" and "LL Centre" tags from the map as they correspond to the categorization of the SMS project, and it results to be unclear for the sake of the

²⁰ EU Mission: A Soil Deal for Europe. https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/soil-deal-europe_en#funding-opportunities

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map. This decision could potentially lead to confusion since the funded Soil Health initiatives will also be featured on the same website.

Stage 2: Understanding

During this phase, ENOLL, with support from Trust-IT, created an excel document displaying all the initiatives that were listed in the SMS map. This document served as a centralized repository to develop the review process. The file contained information provided by the initiatives, including descriptions, initiative types (LL and/or LH), soil types, and analysing whether the provided details aligned with the map's overarching goals.

The review process meant to encompass a meticulous examination of each mapped initiative, which included the collection of contact information for every potential SHLLs and LHs featured on the map. To ensure a systematic and efficient review, the initiatives were evenly distributed among PREPSOIL participants involved in T4.2 who were asked to identify if among the initiatives they were assigned to, where there “not soil-related” or “not active” initiatives. In this context, “not soil-related” refers to topics outside the scope of the Soil Mission and soil-health related matters; and “not active” refer to those initiatives that are currently inactive.

Stage 3: Cleaning

In this phase, the self-registration form on the PREPSOIL website was updated to make sure that all the information was gathered in the registration process of new initiatives²¹.

ENOLL provided guidance to the task participants who were asked to contact the initiatives they were assigned to and invite them to re-register on the map and update their information. This also served to initiate contact with the potential LLs and LHs highlighted on the map.

The T4.2 partners asked - by e-mail - the previously assigned initiatives whether they were interested in remaining on the map, urging them to re-register through the new self-registration form. Thus, the re-registered initiatives and the new potential SHLLs and LH were included in the database, and therefore will be added into the new version of the map.

Current status

As from January 2024, 219 initiatives have been contacted by the T4.2 participants, of which 64 officially re-registered through the new self-registration form. Additionally, 23 new potential SHLLs/LHs have completed registration.

Stage 4: Re-mapping

Stage 4 entails the re-mapping process, aiming to generate the updated PREPSOIL map. This achievement will be realized through:

- New initiatives that have registered through the self-registration form will seamlessly be integrated into the map, showcasing the project's dynamic evolution.
- Unresponsive LLs that did not provide answer to the initial contact made by task partners and did not re-register will be reassigned among task participants in order to contact them again

²¹ PREPSOIL map self-registration form. <https://prepsoil.eu/prepsoil-map-self-registration-form>

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and ask them to register to the Map. The goal is to ensure that the effort of the SMS project is not lost and that the invite to remain on the map is received.

- A self-assessment form is being developed to help SHLLs and LHs define their level of maturity and the weak points that they should address. This self-assessment tool will support the potential SHLLs and LHs in self-evaluating their alignment with the Soil Mission criteria (**Annex 1: Soil Mission Criteria**). It will enable them to identify which Soil Mission criteria they currently meet and pinpoint the areas where improvement is needed to fully comply with these standards. The form is under development. As soon as the self-assessment form is ready, T4.2 participants will approach the SHLLs to encourage them to fill the form.
- The connection between sites and SHLLs/LHs will be visualize in the map.
- In the upcoming stage, a re-mapping process is planned once SHLLs and LHs funded under the Soil Mission will be announced. They will be invited to register on the PREPSOIL map and will be displayed to visualize the SHLLs and LHs officially funded.

Next Steps and Conclusions

To ensure the map remains up to date, the following updating process will be implemented:

In collaboration with Trust-IT, ENoLL is currently identifying and removing initiatives classified as “not soil-related” or “not active” initiatives.

Unresponsive LLs which did not provide answer to the initial contact made by task partners and did not re-register will be reassigned among task participants in order to contact them again and ask them to register to the Map. The goal is to ensure that the effort of the SMS project is not lost and that the invite to remain on the map is received.

- Every two months, ENoLL and Trust-IT will review the results from the self-registration form. Those entities recognized as potential SHLLs and LHs that have successfully completed the application process will be incorporated into the map.
- Once the SHLLs and LHs will be funded under the Soil Mission, they will be shown in the map and the Soil Mission objectives they are addressing.
- Continue the mapping of potential SHLLs and LHs to achieve the KPI of mapping and reaching out to +150 potential LL/LHs.

In conclusion, the PREPSOIL project initiated the mapping of potential Soil Health Living Labs and Lighthouses, aimed to understand and clean up the data provided by SMS, distinguishing between initiatives and ensuring geographical and land-use coverage. The resulting map configuration allows filtering by different criteria. The roadmap to the PREPSOIL map involved revising, understanding, cleaning, and re-mapping stages. The ongoing efforts include contacting and re-registering initiatives, developing criteria for Soil Health Living Labs, and planning for the re-mapping process to showcase funded initiatives. Regular updates will ensure the map reflects the evolving landscape of Soil Health Living Labs and Lighthouses, supporting the objectives of the Soil Mission.

Annex 1: Soil Mission Criteria

Table 2. Criteria for the selection and set-up of living labs and lighthouses (Source: Soil Implementation Plan)²²

Type of criteria	Description
Aims	<p>Innovation and co-creation.</p> <p>Formal learning.</p> <p>Contributing to societal challenges, sustainability, and resilience.</p> <p>Improving soil health and ecosystem services, thereby achieving the soil mission objectives in a holistic manner (minimising trade-offs) in the specific context of the region in which it operates.</p>
Activities	<p>Outreach and facilitation of engagement of the land users.</p> <p>Co-design/co-development/co-creation of innovations focused on improving soil health and ecosystem services, in major soils and land use systems in a given region/area.</p> <p>Experimentation of innovative practices and solutions using transdisciplinary, multiactor, systems approaches, in real-life settings, seeking to adapt scientifically-proven solutions to local conditions (on real farms, forest exploitation or urban soil management sites).</p> <p>Measurement/monitoring/evaluation of impact of innovative practices/approaches on soil health and related ecosystem services at site and landscape levels, involving research and innovative measurement technologies (data management, sensing, monitoring, assessment modelling).</p> <p>Evaluation of socio-economic impacts and behavioural drivers and lock-ins related to the adoption of the innovations by soil managers.</p> <p>Contributing to networking and knowledge exchange with other sites/LL/LH & EIP-AGRI.</p> <p>Testing, validating and improving the comprehensive soil and ecosystem monitoring system through co-creation (including assessment, training and education on tools).</p> <p>For sites that have reached a high level of performance (lighthouses):</p> <p>Demonstration, dissemination and promotion to soil managers, the public and the policy arena, at landscape scale and beyond, of land-use systems that satisfy criteria for sustainable development, in particular in terms of soil health and related ecosystem services.</p> <p>Reaching out to the policy arena linking results of the LH's to environmental rules and regulations. This in line with science-based policy support and governance.</p>
Participants	<p>Public-private-people partnership involving if possible four groups: science, policy, practice, citizens.</p> <p>Active engagement in co-development and experimentation of the multiplicity of users having an impact on the achievement of the societal goals.</p> <p>Users of primary importance to achieve the soil mission objectives: soil managers (farmers, advisors, foresters, city greens managers, allotment holder, industries with</p>

²² Soil Implementation Plan. https://research-and-innovation.ec.europa.eu/system/files/2021-09/soil_mission_implementation_plan_final_for_publication.pdf

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	<p>impacts on soils etc.) and researchers. They would have the responsibility early in the process to connect with other interests such as: associations and organisations with an interest in soil health and related ecosystem services, local or regional government, scientists from a variety of fields outside soils (natural sciences, social and behavioural sciences etc.). The list of users may depend on the specificities of the places and challenges that are specific to that place.</p> <p>For demonstration activities: target audiences include soil managers, the public arena and relevant networks such as for example EIP-AGRI.</p>
Context	<p>Transdisciplinary and participatory approach.</p> <p>Multi-method approach.</p> <p>Place-based; well defined system boundaries (e.g. farm, (sub)-watershed, neighbourhood, NUTS region, value chain) of relevance to soil challenges. This relates to specific regions and sectors.</p> <p>Real-life context = real farms/forest or urban/industrial sites, seeking to go beyond current practice.</p> <p>Long-term set-up.</p> <p>Openness, communication and dissemination and connection with networks.</p> <p>Multiple dimensions: technical, economic, social.</p> <p>Robust scientific set-up for ecosystem assessment.</p>

Milestone 6 – Material and prototype for virtual LL&LH interactive maps ready

MS6 Material and prototype for virtual LL/LH interactive maps ready



Preparing for the 'Soil deal for Europe' Mission

GA number: 101070045

Milestone 6

Material and prototype for virtual LL/LH interactive maps ready

Title	Material and prototype for virtual LL/LH interactive maps ready
Work package no:	4
Milestones no:	6
Milestones description:	This document describes the updates to the PREPSOIL Living Labs and Lighthouses interactive map, detailing the rationale behind each version's release, the publication dates, and their cumulative impact on identifying and mapping LL and LH initiatives.
Due date:	April 2024 (M22)
Submission date:	26 April 2024
Authors:	Mar Ylla Gelabert
Version:	V4

Project acronym:	PREPSOIL
Project name:	Preparing for the 'Soil Deal for Europe' Mission
Project number:	101070045
Call topic:	HORIZON-MISS-2021-SOIL-01-01
Type of action:	HORIZON-CSA

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Table 3. List of contributors

Organization	Contributor
ENoLL (WP4 Leader)	Mar Ylla Gelabert, Alberto Cerezo & Giulia Campodonico
Trust-IT (WP3 Leader)	Valeriya Fetisova
AU (Project coordinator)	Line Friss

Table 4. Revision history

Version	Description
V1	Initial creation of the milestone by ENoLL.
V2	Updated to include contributions from Trust-IT.
V3	Enhanced with contributions from AU.
V4	Finalized version.

Abbreviations

CMS	Content Management System
ES	Experimentation site
EU	European Union
KPI	Key performance indicator
LHs	Lighthouses
LLs	Living Labs
M	Month
MS	Milestone
O5	Objective 5
REA	European Research Executive Agency
SHLHs	Soil Health Lighthouses
SHLLs	Soil Health Living Labs
SMS	Soil Mission Support
T	Task
WP	Work Package

Introduction

The Mission "A Soil Deal for Europe" – hereafter referred to as Soil Mission - aims to establish 100 Living Labs (LLs) and Lighthouses (LHs) by 2030, leading the transition toward healthy soils. According to the implementation plan of the Soil Mission²³, soil health living labs (SHLLs) and soil health lighthouses (SHLHs) are defined as follows:

- “Soil health living labs” (SHLLs): “user-centred, place-based and transdisciplinary research and innovation ecosystems, which involve land managers, scientists and other relevant partners in systemic research and codesign, testing, monitoring and evaluation of solutions, in real-life settings, to improve their effectiveness for soil health and accelerate adoption.” These living labs are collaborations between multiple partners that operate at regional or sub-regional level and coordinate experiments on several sites within a regional or sub-regional area (or working landscapes).
- “Lighthouses” (SHLHs): “places for demonstration of solutions, training and communication that are exemplary in their performance in terms of soil health improvement”. They are local sites (one farm, one forest exploitation, one industrial site, one urban city green area, etc.) that can be included in a living lab area or be situated outside a living lab area.

The PREPSOIL (Preparing for the "Soil Deal for Europe" Mission) project aims to facilitate the Soil Mission's implementation across European regions. This involves the collaborative development and implementation of tools and platforms for interaction, knowledge-sharing, and co-learning. Additionally, the project includes stocktaking and dialogue to comprehend how a regional assessment of soil needs, supported by standardized monitoring mechanisms, can translate into action within living labs and exemplary projects focused on promoting soil health.

Within Work Package (WP) 4, led by the European Network of Living Labs (ENoLL), the focus is on “Knowledge transfer and co-creation in regional Living Labs.” Among the different tasks included in WP4, Task (T) 4.2 is dedicated to the “Identification and mapping of Living Labs and Lighthouses”. The main goal of T4.2 is to identify and map both current and emerging LLs and LHs in an interactive virtual atlas, showcasing LLs and LHs on the PREPSOIL webpage to support collaboration and knowledge sharing among similar ecosystems throughout Europe.

This effort aligns with Objective 5 (O5), which emphasizes the mapping of current and emerging LLs and LHs to enhance networking and knowledge exchange. The goal is to visually represent over 150 Soil Health LLs and LHs, meeting the corresponding Key Performance Indicator (KPI). By June 2024 (M24), T4.2 aims to have successfully engaged with and mapped relevant regional LLs and LHs sites for the Mission.

This report provides a comprehensive summary of the materials and prototype developed for the virtual LL and LH interactive atlas, marking the completion of Milestone (MS) 6. It outlines the evolution of the PREPSOIL Living Labs and Lighthouses map²⁴ through its published versions, explaining the rationale for each update, including the release dates. These versions were produced in collaboration

²³ Soil Mission Implementation Plan. https://research-and-innovation.ec.europa.eu/system/files/2021-09/soil_mission_implementation_plan_final_for_publication.pdf

²⁴ PREPSOIL Living Lab and Lighthouses Map. <https://prepsoil.eu/living-labs-and-lighthouses/map>

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with T4.2 participants, with technical modifications executed by WP3 leader (Trust-IT) responsible for developing, managing and upgrading the PREPSOIL web portal. For detailed insights into the specific steps undertaken during this development, please refer to MS5 “Guidelines for mapping LLs and LHs”.

The versions of the PREPSOIL map

The following sections will dive into the specifics of the different versions of the PREPSOIL map, which are briefly described in Figure 1.

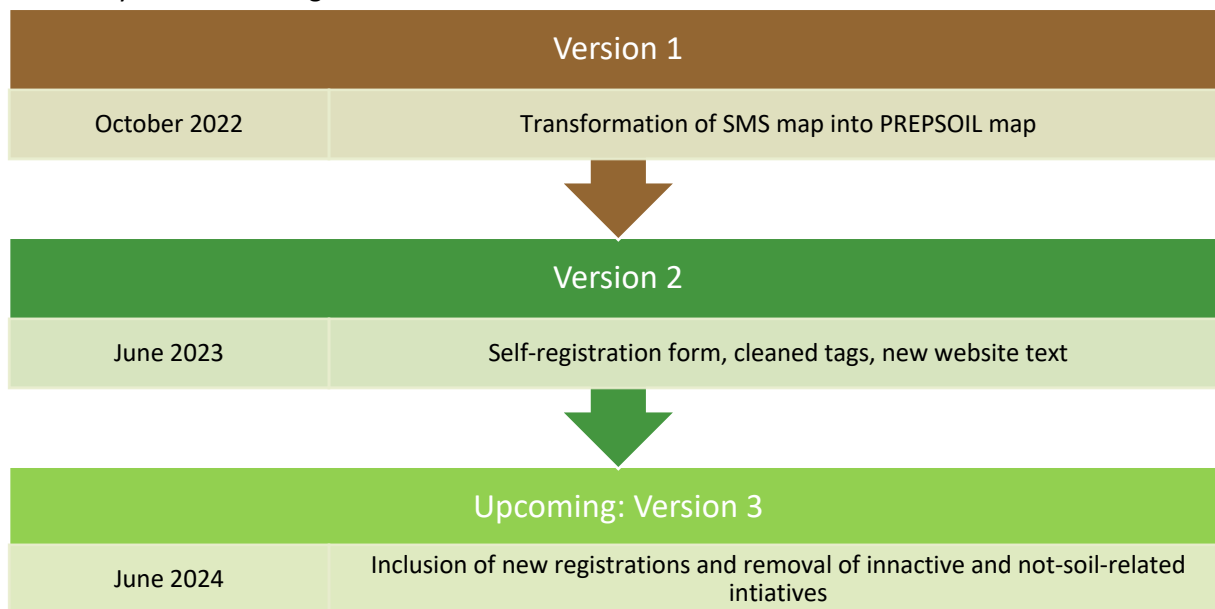


Figure 1. Summary of the versions of the PREPSOIL map

Version 1: Preliminary map (October 2022, M4)

In October 2022 (M4), the initial version of the PREPSOIL map was released, featuring a detailed map that included data on LLs and LHs derived from the Soil Mission Support (SMS) Project²⁵ (GA: 101000258) (see Figure 2).

²⁵ SMS Project Map: <https://esdac.jrc.ec.europa.eu/maps/livinglabs/start.html>

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Figure 2. SMS map

The first version of the map has been built on the data and set-up provided by the SMS Project and further enhanced with a more modern visualisation framework based on Google Maps. This enabled more customisation options and interactive functionalities in comparison to the original map. Furthermore, the filters have been refined in their underlying technology to ensure a more accurate visualisation of the location on the map. This has also enabled the selection of the LL/LHs on the map without a "Submit" button.

The filters in this first version of the map included:

- Type: Living Lab site, Lighthouses, or All
- Filter for LL & LH: Agriculture, Forestry, Urban, Protected Areas, Industry, Infrastructure, or Other
- Filter by Funding: EU Funded, All, or Others

Additionally, the icons for the mapped initiatives were differentiated by various pin colours to indicate the following types: Living Lab, Lighthouse, Living Lab and Lighthouse, Living Lab Center, and EU funded. Alongside the map, this version contained a text introducing the goals of the PREPSOIL map in relation to the T4.2 and the Mission Soil.

Version 2: Confirmation of the initiatives and self-registration process (June 2023, M12)

In June 2023 (M12), the second version of the PREPSOIL map (Figure 2) was released together with a new self-registration form. During this time, a consensus was reached on adopting new terminology, where LLs would be referred to as "initiatives," since they have the potential to evolve into SHLLs. This process was supported by the Mission Secretariat and European Research Executive Agency (REA), who gave valuable input through consecutive meetings and exchanges.

Initially, projects were referred LL, LH, or LL/LH which implied a certain level of alignment with established EC criteria. However, it was recognized that not all projects had been fully assessed against these criteria to qualify as LLs or LHs. To avoid potential confusion and misinterpretation about the criteria and relevance of each project, a consensus was reached to adopt the term 'initiatives'. This

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term more accurately indicates that these potential LLs/LHs are in developmental phases and may evolve into SHLLs as they mature and meet specific criteria.

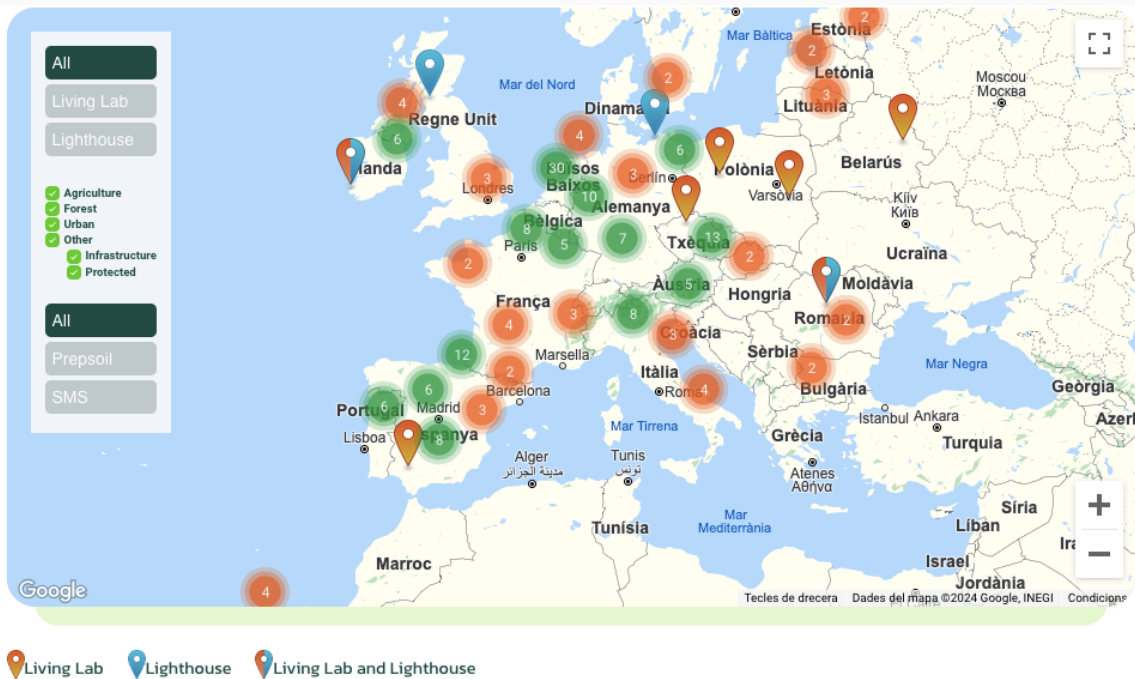


Figure 3. Map configuration, version 2

The self-registration webform aims to harmonize the collection of information from initiatives seeking registration on the map. It captures key location, contact and classification details:

- the name of the LL/LH,
- location (country and full address)
- type of soil addressed (Agriculture, Forestry, Natural, Urban, and Other) with multiple selection possibilities,
- contact person name, email, and role,
- general and public contact email, phone number,
- website,
- description of the LL/LH.

The new features of this improved self-registration form are an automatic geolocation and the option to link “experimentation sites” (ES) to the main LL during the registration process. Additionally, the results obtained from this registration form will be integrated on the map in the next version release. The second version of the map displayed a total of 218 LLs/LHs. This update differentiated between “PREPSOIL” and “SMS” to clarify the source of the mapped data.

Additionally, a new section was introduced on the website under the LL section to provide a detailed explanation of what SHLLs and SHLHs are and highlighting their significance in the context of the Soil Deal Mission. Furthermore, this version also included a disclaimer indicating that the displayed LLs and LHs do not necessarily align to the Mission Soil criteria.

Upcoming Version - Version 3 (expected release June 2024, M24)

The third version of the map is expected to be released in June 2024 (M24). This version will include revisions to all mapped initiatives, with new entries collected through the self-registration form and

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those derived from the SMS project. The initiatives from the SMS project have undergone a comprehensive cleaning process conducted by task participants (details in MS5 – Guidelines for mapping LLs and LHs).

In its third release, the PREPSOIL map will add another layer of technical advancement, becoming more integrated with the Drupal Content Management System (CMS) used for the website: the list of pins on the map will no longer be on a stand-alone .json file, but will be based off a specific content type in the CMS. This change will reduce the current effort of updating the map visualisation tool by removing manual actions and allowing for a more streamlined process of content approval directly in the CMS. This version will display the results from the revisions that determine which initiatives are still active and relevant to soil health topics. The inactive initiatives or those unrelated to soil health will be removed. Simultaneously, new initiatives registered through the form will be integrated into the map, showcasing the project's ongoing development. This version will also fix errors in descriptions as well as errors regarding the location of the initiatives. Furthermore, it will see the removal of the "Living Lab Centre" and "EU funded" filters and icons from the map, a decision made after a discussion held with the European Commission and in collaboration with task participants. To ensure consistency and align with the land-use categories identified and utilized in PREPSOIL, the "natural" category will be removed from the self-registration form and map. In its place, the "land-use types" filter will only display five categories - agriculture, forestry, industry, urban, and other – acknowledging that the same mapped initiative could be pertinent to more land-use types at once.

Through the length of this task and as of date, contact has been established with a total of 223 initiatives of LLs and LHs. During this time, the T4.2 partners with guidance from ENOLL were asked to assess the initiatives to see if they are soil-health related, active, and if they truly are initiatives with potential of becoming LLs and LHs. Such assessment was done through direct contact with the LLs, details can be found in MS5 – Guidelines for mapping LLs and LHs. As of April 2024, the results from such process have led to a total of 107 initiatives, which can be LLs, LHs or ES. Initiatives that have not responded despite repeated attempts or could not be reached will be notified about the removal of their data from the PREPSOIL map. The results of this cleaning process will be displayed in version 3 of the map, along with the new registrations that have been obtained until the release of the next version 3, expected in M24, and onwards until the end of the project.

Updating process

To ensure the map remains up to date, every two months and until the end of the project, ENOLL and Trust-IT will review the results from the self-registration form. Those entities recognized as initiatives of SHLLs and LHs including the ES, that have successfully completed the application process will be incorporated into the map.

Brussels and 27 June 2024

ANNEX 5. Conceptual framework situating the role of living labs to improve soil health



PREPSOIL – Preparing the ground for healthy soils: building capacities for engagement, outreach and knowledge

Reference document **Conceptual framework situating the role of living labs to improve soil health**

Document	4.1
Work Package and task	WP4 task 4.1
Document type	Reference paper
Dissemination level	PREPSOIL consortium before Public
Leader	INRAE
Date 1st draft	27 Feb 2023
Date finalisation	October 2023
Version	Final version
Contact	Muriel Mambrini-Doudet (muriel.mambrini@ird.fr) & Bastian Gödel

History of changes

Revision	Date	Author	Comments
V1	February 2023	Mambrini-Doudet & Goldel	Prepsoil partners task 4.1
V2	May 2023	Mambrini-Doudet & Goldel	Prepsoil partners task 4.1
V3	October 2023	Mambrini-Doudet & Goldel	1 st integration of the outcomes from the workshops
V4	November 2023	Mambrini-Doudet & Goldel	Final integration of the outcomes of the workshops after additional literature review
V5	July 2024	Mambrini-Doudet	Final review upon task leader request (English spelling)

Disclaimer

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Abstract

The conceptual framework for using the living lab approach to improve soil health according to the 8 objectives defined by the “Mission A Soil Deal for Europe” comprises:

A model of change outlining the activities to improve soil health and the way to implement them that will accelerate the changes, effective for every soil use

A map setting the unique and expected features of living labs (LLs) designed to improve soil health, whatever the soil use (generic features)

3 tables specifying the specific features of living labs for improving soil health in i) agroecosystems, ii) urban areas, iii) industrial surroundings/brown fields

An ideation to anticipate the feature of living labs for soil health in natural areas

A reflection regarding living labs in forest areas, considered as “mixed”, combining, according to their specific situation, the features from agroecosystems, natural areas, urban and industrial living labs.

The method to co-design the conceptual framework comprised 4 steps:

The drafting of the model for change and generic features of living labs based on the outcomes of former European projects (CSAs) aiming at setting the scene

for improving European soil health, and more generally, for developing LL for the agroecological transition or improving urban resilience, completed by literature analysis

The 1st proximal revision of the model by the contributors to the task and the identification of missing expertise to improve the precision of the framework thanks to regular monthly meetings

The 1st proximal iteration with the members of the consortium, thanks to 2 successive collective intelligence workshops.

The 2nd iteration with experts not included or sufficiently represented in the consortium, thanks to a collective intelligence workshop.

The outcomes are: the conceptual framework synthesised in 6 maps (model of change, generic features of LL for soil health, and 4 specific features for agroecosystems-urban-industrial-natural areas LL for soil health), background to consider forest LL for soil health as approaches mixing the specific features of LL for the 4 different land uses, and a kit to implement workshops aiming at collective design for improving soil health.

Objectives

The objective of this work is to specify the features of the Living Labs (LLs) that are and will efficiently improve soil health according to the eight challenges outlined by the Mission "A soil deal for Europe".

It is a significant step towards improving the understanding of how LLs and Lighthouses (LHs) can lead to a significant improvement of soil health. The intent is to provide the taxonomy that will support the mapping of current and emerging LLs and levers to engage LLs in their development (Task 4.2). Such an inference should also provide the framework to co-design the spectrum of model business plans (Task 4.3) considering the high variability among LLs, the diversity of land use and of the European situation regarding soil health. More generally, the framework should also support the accuracy of the service package for knowledge transfer and co-creation for LLs, prioritising specific soil needs that are foreseen in Task 4.4. More generally, it should support sharing a common background, firstly among the partners of the consortium and then with the LLs and LHs significantly engaged in improving soil health in every European member state.

Methods

The knowledge maps that were successively built are:

a) the generic model of change:

- the orientations of the activities that will adequately support the improvement of soil health according to the eight objectives selected by the Soil Mission
- the values that will support the engagement of the actors to engage in the transition.

b) the generic features of LLs significantly contributing to soil health improvements based on the model of change, knowing the activities generally developed in LLs

c) the unique features of LLs for soil health for five land use types [agriculture, urban soils, (post-)industrial sites, natural areas and forests], by merging the characteristics of LLs that already exist and that are described in each socio-economic sector (agroecosystems, cities, industries/ brownfields and natural areas) to support the open innovation processes in each, and their refinement to accelerate the expected transitions. Regarding forests, they were considered as mixed land use (from production to natural areas, an invitation to combine the unique features of LLs for each type of land use on purpose).

The steps were as such:

The drafts were initially provided by the lead INRAE based on the integration of the work undertaken in the different Coordinated Support Actions (CSAs) aiming at situating the potential of LL for improving soil health (SMS), or agroecology transition (ALL-Ready; AE4EU) as well as recent insights from ongoing European and Canadian LLs and completed, when needed by literature analysis. The partners of Task 4.1 were then invited by the lead, during monthly meetings, to check collaboratively the variables of the generic model, refine the actions to be undertaken and the conditions of implementation, and discuss the foreseen attributes of LLs per land use. After the checking was completed, it was time to open the drafts to additional and complementary expertise. The partners of Task 4.1 were invited by their lead to co-design a workshop aiming at sharing the conceptual framework with invited experts and a diversity of stakeholders for critical assessment and additional refinement. After having set the frame and material for a 2-hour remote working session, three successive workshops were organised, two within the PREPSOIL consortium, one with complementary expertise (industrial and brownfield lands).

The initial generic model of change and characteristics of LL per land use were drafted merging the results of the All-Ready (Mambrini et al., 2022), and the SMS (Maring et al., 2022) projects, completed with literature analysis and workshops. The actions and recommendations were categorised according to two plans: the activities and their implementation conditions that will lead to a significant acceleration of the transition to sustainability. This map makes it easy to embrace the variables of the generic model of change. This later was used to infer the features of LL for each land use, in other words, the generic attributes of LL for soil health, categorised in terms of specific aims, activities, participants and context. Some LL are already in place or developed for specific land use types in Europe and abroad, that are foreseen to have an interesting impact on soil health, and for which references are available (scientific or grey literature): LL for the agroecology transition in the agroecosystem and forestry sectors, LL to improve resilience in the urban areas, LL for the social and environmental responsibilities of industries. The results of such LL published in the academic or grey literature, or shared through workshops or interviews, were checked and related to the generic model of LL for soil health to infer the features of LL for soil health per land use. The LLs were thus categorised, in terms of specific aim, activities, participants and context. In doing so, we prepared the base for the networking of LL whatever their domain of application, and their interconnectedness at the landscape, European or international levels. Regarding natural area and forest LL, we had to develop a specific strategy to specify their expected features. In natural areas, we hardly find living labs. Their day-to-day management relies on multi-actor concertation, and the development of open-innovation arrangements for a specific purpose with a co-design process might

not be an easy option. To identify the expected features of LL for natural areas, we opted for collective creativity sessions on what the LL could positively add towards soil health objectives. Regarding forests, we had to reconsider our initial assumption. In the first instance, we combined the features of LL for soil health in forests with LL for soil health in agroecosystems, because we hardly found features specific to the latter that would not be found in the former. However, through the iterative working sessions, after the two workshops and a specific working session held with the forest experts of Prepsol, the best way to specify the features of LLs for soil health in forests is to consider that they are mix of land uses between agroecosystems, natural areas, industrial and urban environments.

Three 2-hours workshops were implemented, two with the members of the PREPSOIL consortium, and one with stakeholders with complementary expertise (urban and industrial land use). Besides checking the completeness of the features that can be expected for each land use, the objective was to facilitate the sharing of the conceptual framework with the members of the consortium and to act for building the common vision. Workshop participants were invited to work in small groups to discuss all the features, to check and eventually add missing ones, and then to co-design the expected features of LLs for natural areas. The method and materials are made available as a “kit” to be used by the members of the consortium or other leaders to share the conceptual framework as a common vision to engage their stakeholders.

Additionally, the driving forces identified can serve to evaluate or build policy incentives for the future and become powerful tools for policy-makers to revise existing regulations and to strengthen the transition process while safeguarding the public interest. Therefore, the principles and activities listed below should provide frameworks for future actions through co-creation. In detail, we have identified the main pillars and common goods orienting the recommendations for developing activities to sustain healthy soils. They provide reasons for building a balance of public, private and common goods with the perspective of reaching the goals for healthy soil. In the tables below, we grouped, on the left hand side, the main principles and context for healthy soils and on the right hand side, categories of actions that support the transition to healthy soils, generically and specifically in agricultural, urban, industrial and natural areas.

Results

Pillars of the improvement of soil health and their underpinning activities

The results are summarised in two tables and one figure.

Firstly, we outlined the driving forces of the transition to sustainability in general and specified those that will have a significant impact for soil health. They are translated in Table 1 in terms of what should be incentivised and what principle should orient the actions.

In more detail, regarding the model of change, we departed from the results of the All-Ready project (Mambrini et al., 2022), in which the activities and values that are relevant for accelerating agroecological transition were mapped based on merging the recommendations for transition published by a broad range of organisations, research institutes, as well as statements and review papers. The CSA SMS (Maring et al., 2022) also developed and published similar outputs for improving soil health. The additional activities and values essential to the improvement of soil health were added to the map. We ended with a mind map outlining the diverse categories of activities that can be implemented to improve soil health and the conditions for efficient implementation. Such a map helps encompass the diversity of activities that accelerate changes, the features of the context for their successful implementation, and the specific orientations of the innovations and evolution of practice that are expected for improving soil health. Such orientations can be seen as the initial driving forces moving the communities and the various stakeholders in the transition process towards healthy soils. The activities should evolve over time, while the orientations of the changes remain.

Table 1: Fundamental pillars to secure the transition to sustainability in different economic sectors and the special attention to be addressed for soil health (in brown)

To incentivise	To check regarding the action
<ul style="list-style-type: none"> • Regeneration of ecosystems and ecosystem services • Land and natural resource governance • Care of nature 	<ul style="list-style-type: none"> • Improve biodiversity preservation • Mitigate climate change • Concerns for soil, water and land preservations
<ul style="list-style-type: none"> • Equity and social well-being of rural/urban/worker/citizen livelihoods • Synergy among activities • Fairness • Social values associated to soil 	<ul style="list-style-type: none"> • Guarantee collective rights, participation and access to the commons • Ensure inclusion and consideration of diversity • Strengthen local empowerment
<ul style="list-style-type: none"> • Co-creation of knowledge and participation • Creativity • Connectivity 	<ul style="list-style-type: none"> • Promote the diversity of knowledge • Clarify and ensure data access and openness

The changes of practices have been gathered in five categories, which are not exclusive of each other:

- Develop synergies: enhancing key functions across diversified production systems that use the complementarities between the elements of the system.
- Seek efficiency: producing more using fewer external resources, manage the resources for reduced input, substitute with alternate systems and practices, and opt for recycling to decrease economic and environmental costs
- Improve resilience: improve resilience of ecosystems, economy, communities, and collective preparation to disturbances, strengthen long term management of resources, opt for diversification
- Adapt to and mitigate climate change

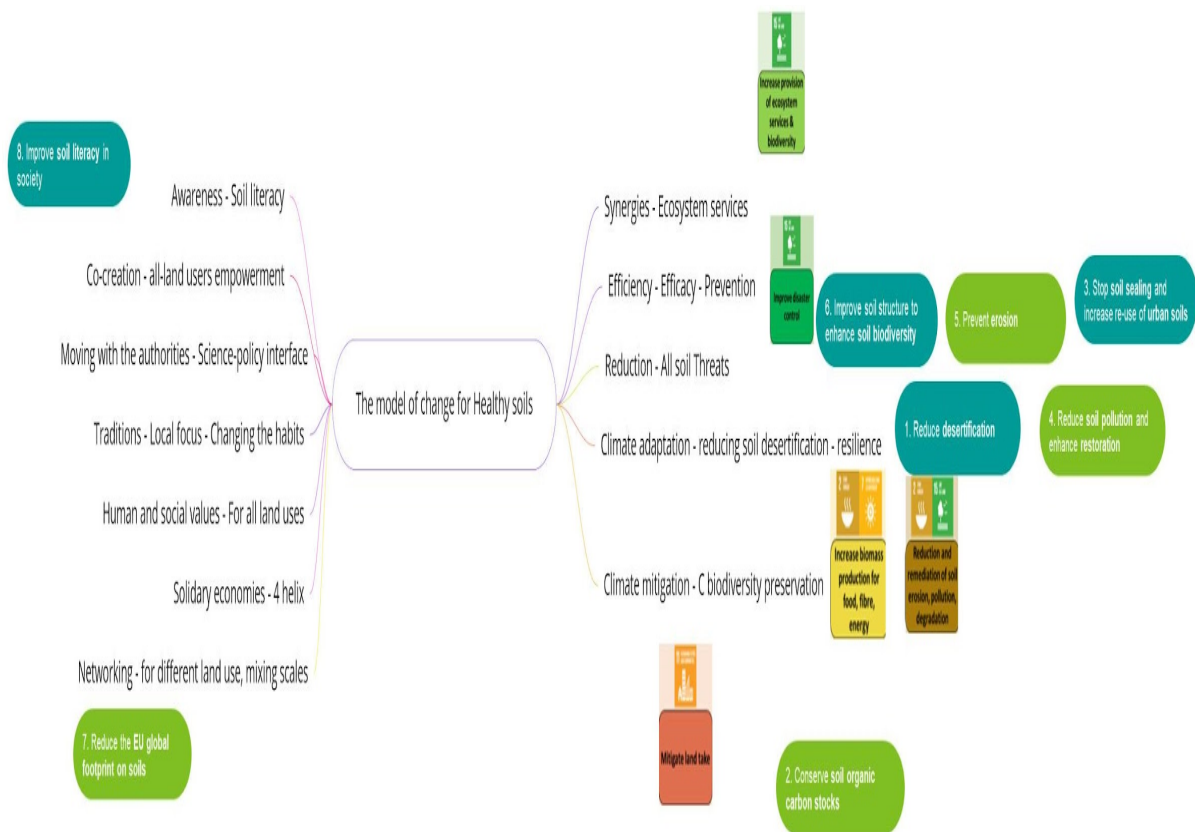
- Opt for decreasing the environmental and economic costs

The conditions for accelerating change fall into three categories complementing each other:

- Opt for co-creation and participation, through knowledge sharing and collaboration; welcoming tacit and implicit knowledge and knowledge of local communities, foster participation of multi-stakeholders at local and global scales, develop responsible governance mechanisms at local, regional, national and global scales, involve the people from producer to end-user, value the commons goods and inclusiveness
- Consider social and cultural needs, habits and traditions, human connections to the surroundings, food and nutrition security, the spiritual and material relationship with the land and environment
- Promote the evolution of the economic model to develop a fair and circular economy that reconnects producers and consumers within sustainable boundaries and gives added value to solidarity

We took this framework as a backbone to specify, based on expert inputs (partners of task 4.1), what should be the specific orientations of the activities to be undertaken and the conditions under which they should be implemented for improving soil health (figure 1).

Figure 1. Overview of the orientations of the activities for transition for a significant impact on soil health and correspondence with the eight specific objectives and main targets identified by the Mission “A Soil Deal for Europe”



To improve soil health, the changes of practices could be oriented as follows:

- Regarding synergies, it is of interest to enhance concerns in terms of ecosystem services
- Efficiency is to be linked to efficacy and to the development of prevention models
- The goal of reduction is not only in terms of resource use but also in terms of soil threats
- Concern with climate change adaptation and mitigation should be at the top of the agenda.

Regarding the way to implement such changes, providing the accurate context for change means:

- Build awareness at each level of the society, improve soil literacy.
- Co-create activities, changes of practices thanks to the engagement of the many different land users and related actors; such activities should also seek the empowerment effect of the co-creation, collective experimentation process.
- Work under the adequate policy framework, crucial for supporting, promoting, making such changes happen; so working and co-creating with the authorities will greatly improve efficiency. This goes along with a good science-policy-practice interface.
- Take into consideration the social and cultural needs, even more crucial regarding soil health since what is expected is a change of habit in many cases. This will take place locally, so being able to have a local focus is essential.
- Pay specific attention to human and social values and their translations in terms of land ownership, drivers and barriers regarding land use and soil management
- Ask for or promote efforts to develop economic models fit to circular and solidary economies that are essential for the transition and even more crucial regarding soil health; include the actors of the value chain, the ones who are giving the sense to the economy, as part of the co-creation process as much as possible. This, in the language of innovation, is called the quadruple helix: practitioners/land users/industries, science/academics, citizens and policy makers are included.
- Combine the very local scale to the global scale, essential to change the practices and the habits to improve soil health; it should be considered in the aim of the activities but this will not be sufficient; networking activities will be essential to achieve such mixing of concerns regarding such different land uses and the extent of the scales to be combined/considered.

Our next step was to translate the aforementioned activities and ways to implement them, whatever the land use type, to significantly improve soil health (Table 2), thanks to literature analysis, and iteration with actors and stakeholders (see method).

Table 2: The ways to change practice for accelerating the transition to sustainability, in terms of types of activities (right column) and conditions to implement them (left column), in bold what **deserves specific attention for soil health and in colour, what is additional for soil health; the table is a panoramic view, it can be read as such, “I opt to change my practice of soil management by looking for synergies of functions among ecosystems (right column), if I build the actions through a co-creation process and a specific attention to human and historical values (left column), then I can gain efficiency and efficacy”**

Context for implementation	Orientation of the evolution of the practices
<p><u>Develop co-creation and participation</u></p> <ul style="list-style-type: none"> • Through knowledge sharing and collaboration: skills acquisition, intensive knowledge use and production, horizontal exchange (equal rights/voice among the stakeholders) • Through welcoming tacit and implicit knowledge both formal, non-formal, exchange with local communities • Bring users really to the centre (testing soil practices and prototyping in LLS/LHs) • Foster participation for integration into the value and food chain, (at multilevel) of multi-stakeholders at local up to global scales: among LLS, land users, consumers, researchers, academics, ministries, big food and production chain companies, policymakers on different levels among and between LLS • Foster training and education <p><u>Bring human and social values to the centre</u></p> <ul style="list-style-type: none"> • Diversity and equity: between gender, race, sexual orientation, religions; socio-economic background, multi-generational; take in consideration vulnerable people • Cultural appropriateness and history (looking back at the life of our ancestors) • Think in terms of health <p><u>Consider traditions</u></p> <p>As indicators of routines to have indications on how to change the. habits and break routines;</p> <p>To better understand the authorities on different levels (local, regional national)</p> <p>To have keys for changing the way knowledge is shared and the way people work</p> <p>Infer the regional differences of activities that will be proposed or advised and the difference between people that work at discrepant levels (in terms of background, age etc.)</p> <p>Improve soil literacy of the society (as most people know very little about soil and its benefits, opportunities, impacts and problems)</p>	<p><u>Develop synergies</u></p> <p>That enhance key functions across diversified social-, trade- and eco-systems</p> <p>That use the complementarities between the elements of the systems</p> <p>Use landscape and urban planning and management</p> <p>Work on the institutional aspects of synergies</p> <p>Enhance positive interaction and complementarities between the elements of the system = consider ecosystem services for what makes sense for soil health for a certain land use, undertaken with reasonable steps (immediate multifunctional soil health for all land use is not realistic)</p> <p>Open the capacity to undertake additional activities</p> <p>And avoid trade-offs</p> <p><u>Develop efficiency</u></p> <p>To produce the same or more, using fewer external resources: manage the resources for reduced inputs</p> <p>Through efficient recycling strategies</p> <p>Look for substitutions with alternate systems and practices</p> <p>Stop inefficient activities</p> <p><u>Improve resilience</u></p> <p>Of people, communities and ecosystems against disturbances (livelihood resilience)</p> <p>Strengthen long-term management of soil to: conserve plant and animal health, biodiversity, human well-being, economic diversification and to avoid land degradation</p> <p><u>Reduce the factors of climate change and environmental destruction</u></p> <ul style="list-style-type: none"> • Look for mitigation of greenhouse gas emissions • Develop the usage of cover crops, crop rotation and IPM • Lower the use of fossil fuels • Evaluate carbon sequestration and preservation • Reduced use of tillage, pesticides and fertilisers

<p><u>Develop fair and circular solidarity economy</u></p> <ul style="list-style-type: none"> • That reconnects producers and consumers within sustainable boundaries • Think also in terms of opportunities for and promotion of solidarity • Look also at the livelihoods of the workers and entrepreneurs (diversification of incomes, reduction of dependence on aid, community autonomy) • Evaluate the robustness of local markets, economies and employment (Fair prices, respond to local market demand, support regional value generation) • Stop certain negative activities (with or without compensations) such as profit-based decision-making excluding land-users and citizens • Think about developing certifications such as PGS: Participatory Guarantee System or CSA: Community-supported agriculture.... 	<p><u>Adapt to and mitigate climate change impacts</u></p> <ul style="list-style-type: none"> • Look for the adaptation of soil and surrounding system to extreme weather events such as droughts, flooding etc. • Adjust the management of knowledge to mitigate climate change by empowering the knowledge of the people involved (including soil literacy)
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The generic features of Living labs for soil health

Having identified the set of actions that can be undertaken, and the conditions under which their implementation will lead to significant changes, the next step was to specify what living labs can provide and infer their suitable attributes or the features that they should exhibit to enable soil health improvement.

What living labs are

Living labs are innovation arrangements built on three principles: i) co-creation, ii) with users, iii) in real life conditions. While LLs arose in the information and communication technology field, they have developed in other fields, such as city or rural development. Such characteristics make them fit for providing the conditions that might accelerate transition towards (global) sustainability goals: co-create while considering the local culture and habits, foster innovation processes with large set of stakeholders (citizens, industrials, policy makers, academics), consider local up to global scale. Their implementation in agroecosystems, cities, industries, brownfields, forests, natural areas is and can be more and more frequent to accelerate transitions. Living labs can be distinguished from other open innovation arrangements as they develop specific activities in response to the three principles on which they are constituted (co-creation-with users-in real life conditions). For each sector in which they are implemented, they develop unique features. Agroecosystems, cities and industrial LLs can be categorised as different “place-based” LL (Mc Phee et al., 2021) and are characterised by the specificities of their aims, activities, participants and context.

What is known about place-based LLs is that they all operate in a real-world context, working with real communities, in real fields, in practical settings. Their aim is to engage the socio-ecosystem in a transition towards greater sustainability and resilience. This means working within the confines of a particular economic or socio-technical system that requires transition. The boundaries of this system are defined by the local context. The involvement of academics in place-based LLs is a significant feature due to the breadth of knowledge required, the empowering effect expected from the co-creation process and the objective to upscale the local results. In agroecosystems and cities,

the emphasis on multi-actor approaches, incentivised by various policies at the local, national, and international levels, has been critical to innovation for transition. Considering the origin of a LL is essential to characterise its potential to accelerate the transition process. This information helps connect the LL with regulatory frameworks, actors and policies that incentivise its emergence and helps to infer its trajectory towards agroecology transition at the systems level.

Living labs dedicated to social or societal transformation are grounded in three categories of values: business, knowledge, and social. "Knowledge" refers to the co-learning among stakeholders and partners engaged within the LLs and in their home organisations. Three key activities characterise the innovation process in LLs: co-creation, demonstration and iteration (experimentation, evaluation, and improvement). The particularity of place-based LLs is that, in addition, they emphasise environmental values in addition to business, knowledge, and social values due to their local anchorage and aim to improve resilience. They develop specific outreach and networking activities to scale out and up their achievements, particularly at the system level (value chain, landscape, territory). These LLs are also particularly knowledge-intensive and offer possibilities of transgenerational endeavours. Thanks to their local embeddedness, the co-creation process operates on a diverse and particularly heterogeneous knowledge base, including tacit and implicit knowledge. Participants in these LLs include private and public organisations, academics, users, citizens and other stakeholder (Refer to Tables 4.-6. for a specific breakdown)

Inferring the features of LL for soil health

Knowing the activities foreseen to have a significant effect on soil health (see table 2), we reconsidered the general features of place-based LL to specify what is to be added or refined for LLs for healthy soils, in terms of unique aims, activities, participants and contexts, whatever the land use.

Table 3: The table shows the characteristics of place-based Living Labs for healthy soils that are necessary for fostering transition through the activities that will significantly influence soil health as specified in Table 2. The features that all Living Labs show are marked in black, the ones for place-based Living Labs in red and the unique additional characteristics for Living Labs with impact on soil health in brown.

<p>Aims</p> <ul style="list-style-type: none"> ● Fostering innovation processes ● Sustainability and resilience play a major role for soil needs (that can include societal challenges) ● Learning with feedback-loops and building communities that should be integrated within the process of transition ● Working at multiple scales (actors, geographical, size) <p>Activities</p> <ul style="list-style-type: none"> ● Development (beside 'just' testing) of strategies, including experimental innovations ● Co-creation between all different actors and stakeholders involved 	<p>Participants</p> <ul style="list-style-type: none"> ● Role of the land-user as centre of attention: soil managers (farmers, advisors, allotment holders, industrials etc.), associations of organisations with interest in soil health, local administrations, local industries, citizens, academia (in and outside soil sciences) are all part of the processes and equally important ● Policies and policymakers are concerned: government prominence and their link to 'mother organisations' (regional, national, international is essential) <p>Context</p> <ul style="list-style-type: none"> ● Real life context (not just experimental sites) ● Territory, space-bound place with mixed land-use: agricultural, natural, urban, industrial soils are all involved as different land-use
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<ul style="list-style-type: none"> ● Iterations with feedback-loops (<i>see above</i>) as an important base for success ● Orchestration with consideration of the diversity of time frames, and long term changes ● Problematisation: 'shared challenges' problems in which several/all actors are involved in problem-solving processes ● Scaling up and out: outreach and facilitation of engagement, including network dissemination, implementation of activities and adapted legislation practices ● Soil based science-policy interface activities with policy makers (local to regional) are essential to include high-level decision makers ● Economic/Social/Environmental outcomes: Public and private goods, solidarity economy and development of ecosystem services to improve the overall 'well-being' of the locals and participants involved ● Interdisciplinary systems research to tackle problems from a wide range of perspectives and ideas ● Soil literacy as a major activity ● Networking activities to keep people on board and motivated to ensure the longevity of the transition process ● Sustainable funding achievement to ensure important actors are not leaving due to financial constraints 	<p>types exist</p> <ul style="list-style-type: none"> ● System context for transition: system boundaries (farm, neighbourhood, value chain etc.), need to be defined clearly ● Multi-dimensional: techniques, social scales, economic scales, learning adaptability, legislation and policies need to be considered ● Long-term set-up to ensure successful outcomes and participation of actors ● Inter/Transdisciplinary with robust scientific set-up to include variety of actors with high expertise
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1. The unique features of living lab per land use

To identify the unique features of LL per land use type, we imported the features published for LLs in agroecosystems, cities and industries and categorised them in terms of aims, activities, participants and context. We refined these later with the features expected for the transition for each land use type to take stock of the principles, values and open-innovation dynamics that can take place in each land use type, and may lead to a favourable context regarding the changes expected for soil health. We then checked the features according to the generic aims, activities, participants and context expected in LLs for soil health (Table 2) and added additional features for each land use. We built 4 mind maps gathering all the features of LLs for one type of soil use, that were the submitted to critical analysis and completion during the workshops.

▪ Agroecosystem LLs

Table 4: Unique features of agroecosystem LLs (including forestry, until we find more specific activities for forestry LLs) foreseen to have an impact on soil health. We departed from the features outlined for LLs fit to accelerate agroecological transition (results from the ALL-Ready project) and infer the unique characteristics they have to demonstrate to comply with the activities foreseen to improve soil health.

Features	Any LL for the Agroecosystem	LL fit for accelerating AE transition	Additional concerns for soil health
Aims	The overall objective is to work towards greater sustainability and resilience of the system within which the LL operates. Innovation can take the form of new practices, business management or processes.	The option to achieve AE transition is the constant consideration of biodiversity on the site and in the surroundings. Anchoring in the "territory" is essential. The schemes have very diverse origins (from new field practices to experimental policy frameworks), as do the communities involved (farmers, policy makers, consumers, citizens, etc.). As a result, the heterogeneity and quantity of knowledge produced are particularly remarkable (from practices to policies).	The essential additional concern is improved resilience by improved soil health <ul style="list-style-type: none"> - The socioeconomic resilience of the place in which or the sector for which the LL is aiming at accelerating the transition - The sustainability and the resilience of the agri-food system, but of the resilience at the territorial, national or international level - The resilience to climate change

<p>Activities</p>	<p>The amount and level of use of data is particularly high. They are linked to the need to evaluate the performance associated with innovative proposals.</p> <p>The cyclicity of operations is very particular, innovation cycles are seasonal and can sometimes be very long.</p> <p>Linked to external and uncontrollable factors, the level of uncertainty in experimentation and testing is high.</p> <p>The need to take local results to a larger scale, outside the strict perimeter of the living laboratory, is very important. The new practices resulting from a LL must be able to serve at least one sector.</p>	<p>The results, regardless of the location of the LL, are assessed at the system level (value chain, landscape, territory) and the transformation of the latter. The need to obtain and record data at the overall system level is very high.</p> <p>These LL are particularly knowledge-intensive, and the knowledge to be mobilised is notably heterogeneous (tacit and explicit, transgenerational).</p> <p>Given the diversity of stakeholders, it is necessary for the system to be able to avoid the information burden, to have agile governance that considers conflicts of interest, and to orchestrate co-creation.</p> <p>As the more agroecological proposals lead to more diverse products across the value chain, demonstration and iteration require a significant effort, for which experience and know-how of multi-stakeholder innovation processes are an asset.</p> <p>With regard to the knowledge produced, the role of the LL in building the capacity of the actors in the ecosystem is remarkable. It also enables the sharing of knowledge that has not yet been stabilised. These LLs must be carried out over the long term. Agroecology opens up the prospect of redesigning the production system and, because the proposals must adapt to a changing environment, brings with it an additional source of uncertainty.</p>	<p>The additional consideration is related to the peculiar heterogeneity of knowledge, actors, data to be integrated and to the extent of the time scale.</p> <p><u>Knowledge</u></p> <ul style="list-style-type: none"> - Transgenerational knowledge acquisition and fluxes are essential - The time scale is even larger, the effects of the improvements can demand ages - Contributing to the literacy on soil for everyone is essential - Demonstration activities are of additional importance <p><u>Data</u></p> <ul style="list-style-type: none"> - Data collection, modelling to monitor and raise awareness about soil health is also essential to the dynamics of the activities <p><u>Governance</u></p> <ul style="list-style-type: none"> - Due to the heterogeneity of the community engaged, the discrepant capacities to infer the impacts of soil health, the particularly long cycles between the experimentation and record of impacts, the governance of the arrangement take significant efforts and time; one activity that has to be considered as particularly determinant regarding the sustainability of the arrangement is the governance assessment.
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Participants	<p>The involvement of the public sector is particularly important.</p> <p>The involvement of researchers is particularly high.</p> <p>The role of users can be diverse and evolve over time.</p> <p>Due to the relatively high number and diversity of partners involved, in addition to providing scientific knowledge, the governance scheme of LLs is complex in order to maintain the involvement of various key actors in the territories and along the value chain. Researchers are also involved in designing the operation of the LL.</p>	<p>The diversity of participants is quite high. The notion of user is more diverse, it can be the advisor, the farmer, the consumer, the citizen; their role is highly evolutive, for example the farmer can be either the user of the innovation or the provider of a new practice. The opening of the system to the consumer is the major concern.</p> <p>The governance scheme is even more complex to maintain the commitment of the various key actors in the territories and along the value chain. Information flows are more complex and encompass more scales. Decision-making is more decentralised.</p> <p>These LLs produce a combination of private, public and common goods, and in the service of the common goods, which justifies more governmental and research support.</p>	<p>The specification of the types of participants to be engaged in the activity is of utmost importance.</p> <ul style="list-style-type: none"> - Policy makers and governmental organisations - Researchers and research communities of different backgrounds due to the importance of providing inter- and trans-disciplinary activities - Research funding organisations - Land users/managers/owners and their related organisations, and their youth associations - Private sector and industries - Service providers and consultants throughout the value chain - Non-governmental organisations, including the educational, environmental and youth organisations
Context	<p>It is the agroecosystem that is considered. More inter- and trans-disciplinary research is used.</p>	<p>The context considered is that of climate change and food sovereignty issues, beyond the agro-ecosystem considered, put at the scale of the territory concerned.</p> <p>The demand to develop inter- and trans-disciplinary approaches is even stronger.</p> <p>Knowing the origin of the mechanisms, which traces what will have encouraged trust between stakeholders and the sharing of values, is even more essential for characterising the activity. The same is true for the regulatory framework and policies that will have prompted the emergence of the LL. This helps to monitor the trajectory</p>	<p>The boundaries to the place are essential. What makes the LL efficient regarding soil health is its concern with one of the 8 objectives of improvement of soil health specified by the Mission of the European Commission, and its place-based contribution.</p>

		of the LL and to identify the conditions for its longevity, and thus its contribution to agro-ecological transition.	
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▪ **Urban LLs**

Table 5: Unique features of urban LLs foreseen to have an impact on soil health. To identify these latter, we departed from the features outlined for LL fit to accelerate the resilience of urban areas and infer from the results of the SMS project the unique characteristics they have to comply with the activities foreseen to improve soil health

Features	Urban LL	LL fit for improving resilience	Additional concerns for soil health
Aims	<p>The overall objective is to work towards greater sustainability and resilience of the system within which the LL operates.</p> <p>The LL is place-bound, specific to an urban area.</p> <p>Innovation can take the form of new practices, business management, social developments, and formal learning.</p>	<p>The option to improve the resilience of the area considered is a constant consideration, as well as its capacity to up-scale the solutions identified as soon as a positive impact is recorded.</p> <p>Anchoring in the local communities is essential, as well as the development of learning capacities and of adapted schemes to increase awareness.</p>	<p>The essential additional consideration is the interpretation of the activities to be undertaken to increase resilience</p> <ul style="list-style-type: none"> - The circularity of the production/waste management/economy/support to the citizenship - The consideration of the protection of biodiversity as far as possible, and the greening of the city - The adaptation to climate change. <p>This goes along with activities built to:</p> <ul style="list-style-type: none"> - Increase awareness, education of climate change and living soil, the improvement of soil literacy at all levels (schools, community gardens, citizen science, urban farming....) - Consider better well-being in urban planning and real estate (spatial planning, building, redeveloping).
Activities	<p>The co-creation and iteration processes root the activities.</p> <p>The considerations combine economic, environmental and social dimensions at a high level of imbrication. The outcomes are combinations of public and private goods.</p>	<p>The results have to be assessed at a more local level. The need to obtain and record quickly the achievements is very high to maintain the engagement of the various stakeholders and the local communities.</p> <p>These LL are particularly knowledge-intensive and oriented towards raising awareness to support the changes of</p>	<p><u>Co-creation:</u></p> <p>What is more particularly at stake with the co-creation process is:</p> <ul style="list-style-type: none"> - the capacity to find and create local synergies

	<p>The need to take local results to a larger scale, outside the strict perimeter of the living laboratory, is very important. The new practices resulting from a LL must be able to serve other districts or cities.</p> <p>Raising awareness is an essential pillar.</p>	<p>behaviours. All generations should be considered.</p> <p>Scaling up and out, because it is integrated in the aim of the living lab.</p>	<ul style="list-style-type: none"> - a window to analyse how people closely related to the LL are dealing with the changes - the alignment with the existing regulations - the creation of cross-border collaborative networks <p>The co-creation process can work as a policy instrument and offers a capacity to test new policies.</p> <p>Regarding the iterations of any of the experimentations, their aim is also to record quick progress. The need is then to create a fast evaluation process.</p> <p><u>Raising awareness:</u> The first impact expected with the raising of the awareness is the changing of behaviours. The LL thus seeks to analyse, explain, follow and understand each party's drivers and barriers.</p> <p>In this respect, the LL is foreseen to out-scale the capacity to reach a large public, creating special physical zones where experiments can be carried out, evaluated, visited, raising in return awareness to a larger public.</p> <p><u>Imbrication economic-social-environmental</u></p> <p>One activity could be the establishment of an investment fund.</p> <p>Because of the tight imbrication between economic, social and environmental outcomes, such LL are:</p> <ul style="list-style-type: none"> - particularly concerned with recycling and circular economies
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			<ul style="list-style-type: none"> - able to access the latest technologies and in particular IA
Participants	<p>The involvement of citizens and their contribution to the co-creation process marks such LL, as well as the link to local policy makers. Furthermore, local industries, NGOs, academia (from various fields), local administrators, soil managers and companies should be involved.</p>	<p>These LLs produce a combination of private, public and common goods, and in the service of the common goods, which justifies more governmental and research support.</p> <p>The link with policies and policy makers is particularly deep and the connection with local administration is nurtured.</p>	<p>The role of all land users is of primary importance. They should all be considered:</p> <ul style="list-style-type: none"> - municipalities and in these: <ul style="list-style-type: none"> o departments of soil/water/environment/green/public space o spatial and urban planning o departments linked to citizenship and public participation o the departments of economic affairs, health, safety... - Allotment holders - Business offices - Citizens <p>Regarding academia, the contribution of a variety of fields is needed:</p> <ul style="list-style-type: none"> - Spatial planning - Natural sciences - Economics - Social sciences - Behavioural sciences regarding the public - Associations of organisations with an interest in soil health <p>What will be very specific to soil health is that although the co-creation process is undertaken with local actors, these latter ensure the link with their “mother organisation”, because of the global stakes of the improvement of soil health.</p>

Context	<p>It is a real-life context, day to day activities and work.</p> <p>It is place- and space-bound</p> <p>Always with a systemic approach, what can be experimented that will be transmitted and what can be learned that can be shared.</p>	<p>Because such LLs needs to have rapid outcomes, even partial, the particular context for the co-creation and iterations is within the neighbourhood and concentrated in specific areas. It should be ensured that the region or site is also ready for transition to not waste time, money and effort.</p>	<p>What makes the LL efficient regarding soil health is their contribution to one of the 8 objectives of soil health improvement specified by the Mission of the European Commission.</p> <p>The scales that the LL has to consider are particularly large:</p> <ul style="list-style-type: none"> - Metropolitan area including peri-urban area - City boundaries - Neighbourhood - Street <p>The fields of knowledge and expertise to be combined are such that transdisciplinary is to be supported and promoted.</p>
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▪ **Industrial LLs**

Table 6: Unique features of industrial LLs and post-industrial (brownfield) LLs foreseen to have an impact on soil health. To identify these, we departed from the features outlined by the SMS project regarding the activities expected to improve soil health and inferring the subjects that could be handled by industrial LLs. Theoretically, industrial LLs could be separated into active industries (such as ports) and post-industrial sites (such as brownfields). To avoid too many sub-categories, especially as the features for those two do not differ greatly, we decided to keep industrial LLs as one category. Nevertheless, the slightly different features can be seen in the extended mind map built during the workshop (see annex or supplementary material).

Features	Industrial LL	Industrial LL developed regarding social and environmental responsibility of the industry	Additional concerns for soil health
Aims	<p>The overall objective is the opening of the innovation process to resource the goods and points of view of the enterprise.</p> <p>Innovation can take the form of new networks, business management or processes and for social purposes.</p> <p>Other important aspects are soil literacy and formal learning as well as dealing with contaminants and regulations.</p>	<p>The orientation is the resilience and the consideration of the social and environmental role of the activities.</p> <p>The connection and information to neighbouring activities and organisations is an interesting option to incentivise change.</p> <p>Climate change adaptations, biodiversity protection and providing of ecosystem services are strong motivations.</p>	<p>The aims are very specific, should particularly fit with long term transformations (brownfield remediation demands decades) and deal with:</p> <p><u>The innovation purpose</u></p> <ul style="list-style-type: none"> - The cleaning-up of specific sites (point sources and diffuse contamination) by non-invasive, nature-based and (cost-)effective remediation techniques. - Sustainable Risk-Based Site Management considering soil health next to ecosystem and human health) - The dealing with new / emerging contaminants and regulations - Adding value by ecosystem services to enable and improve the praxis of the (re)development and new special planning (brownfields) - The protection of natural capital because of brownfield contamination - Setting up business cases for difficult sites could even be an aim for the brownfields community to help companies/developers (earning money) and

			<p>authorities (solving problems) and the general public (better & healthy living environment)</p> <p><u>The resilience purpose</u></p> <ul style="list-style-type: none"> - The ecosystem services: greening, biodiversity management, natural attenuation, etc. - The preparation for climate change adaptation and climate resilience
Activities	<p>The need to take local results to a larger scale, outside the strict perimeter of the LL, is very important. The new practices resulting from a LL have to serve at a larger scale, at least at the level of the economic sector.</p> <p>Heterogeneity of partners and of the knowledge that they provide for co-creation is key, also for scaling up and out. This means a strong concern with the design of the LL and its management..</p>	<p>The “levels” of motivation are:</p> <ol style="list-style-type: none"> 1. comply with the legislation, 2. the attractiveness of the industry 3. the image of the industry 4. raising the awareness <p>With regard to the knowledge produced, the role of the LL in building the capacity of the actors in the local ecosystem is key for the transformation. It enables the sharing of knowledge that has not yet been stabilised. Because of the sharing of concerns on industrial impacts and global health, these LLs must be specifically carried out over a long term.</p>	<p>The activities shall encompass:</p> <ul style="list-style-type: none"> - Soil and groundwater remediation - Nature-based solutions - Land (brownfield) redevelopment/regeneration incl. circular land use - Sustainable Risk-Based management - Land stewardship <p>They go along with:</p> <ul style="list-style-type: none"> - Innovative approaches to monitoring impacts and effects - The design of new business models - The investment in public awareness
Participants	<p>The range of stakeholders engaged is variable according to the aim and the question of who are and will be the “user” needs to be decided.</p>	<p>These LLs produce a combination of private, public and common goods, and in the service of the common goods, which justifies more governmental and research support.</p>	<p>Participants should cover a wide range of stakeholder groups. From the general public living nearby, to advisors and service providers, to associations of organisations with interest in soil health and the heritage of the site. Altogether, the role of each land-user should be defined.</p> <p>Furthermore, the quality and role of participants might evolve over time; brownfield remediation demands decades.</p> <p>The involvement of soil managers from different origins will be particularly important;</p>

			<ul style="list-style-type: none"> - From local /regional / national administrations (e.g. in the case of publicly owned (post-)industrial areas or brownfields) - Owners / managers impacted by the (historic) industrial use (contamination, impacted soils) - Groups of organisations with an interest in soil health <p>The scale of the industries concerned will shape the dimension of the LL and of its impact (from local to multinational).</p> <ul style="list-style-type: none"> - The link with policies and policy makers is particularly important and the connection with local administration is necessary - The academics will come from a variety of fields in and outside soils (natural sciences, economics, law, social sciences...) - People outside of the field of soils, e.g. from natural sciences, social sciences or economics should be involved to guarantee a sustainable development of the site.
Context	<p>It is the production system and its surroundings that is considered. More inter- and trans-disciplinary research is used.</p> <p>Very important for the context, it was considered to emphasise the real-life context including the promotion of transdisciplinarity and to keep in mind that the scales of sites can differ easily between small sites and megasites in industrial regions.</p>	<p>The context considered is the environmental, social and economic changes linked to climate change</p> <p>As often one important aspect is the financial context to ensure sustainability, from an environmental to a social context over a stable time frame.</p>	<p>The context is the one decided by the industry, often local, but the scale of study and of impact will vary from sites to mega sites, up to regions impacted by industries, and with the scale of the industry concerned. The specific needs of the territory in terms of soil quality and health will be powerful drivers.</p> <p>The boundaries to the LL are essential. What makes the LL efficient regarding soil health is its concern with one or several of the 8 objectives of improvement of soil health specified by the Mission of the European Commission, and its place-based contribution.</p>

▪ **Imagining LLs in natural areas**

Table 7: What needs to be considered in addition to the generic activities of LLs for soil health if they will be implemented in natural areas. Living Labs, and more generally the management through innovation, is not frequent in natural areas, subjected to protection or conservation approaches. How to implement actions for improving soil health is not obvious. Therefore, we needed to imagine what LLs can specifically bring and what would be their unique features under such an application field. We present here the result of 3 workshops of collective design. One of our first results was that there is no “one LL fits all”, they have to be scrupulously adapted to the specific area in which they are implemented. The results presented in the table are not supposed to be exhaustive, but give material for reflexion to improve what can be expected from LLs for soil health.

Area	Aim	Activities	Participants	Context
Protected areas	The aim will be reliant on what needs to be specifically protected. The innovation objectives and pathways will be unusual.	They might be driven by a series of case studies. The searching for connecting areas, territories, countries through geographical collaboration will be high.	The composition of the participants will be totally dependent on the type of protected area concerned. Funders interested in investing in nature protection might be new comers.	It might be difficult to keep the improvement of soil health as a single goal; it will be related to other environmental concerns. On the one side, the broader picture will have to be kept in mind, on the other side, the relation to soil health will have to be nurtured.
- Mountains	<ul style="list-style-type: none"> - The need to transform the territory to face or adapt to climate change will be prominent. - Control erosion; anticipate, model effects on soil health, improve soil structure and cover, also regarding organic carbon - Holistic concerns: climate change, biodiversity, tourism hand in hand with soil health aims for LLs - Integrate soil preservation in natural areas into the socio-economic logic of the mountain territory (work on the articulation/trade-offs (land 	<ul style="list-style-type: none"> - Attracting political attention to mountain challenges - Imagine a common future between the different interests and overcome conflicts of use - In terms of scaling up and out, look for replications in local contexts - In terms of risk management define threshold activities in relation to exploitation - Develop activities good for soil like grazing, and for the well-being - Strong inter- and trans-disciplinary endeavour 	Additional participants <ul style="list-style-type: none"> - Indigenous land holders (with specific rights) - Administrations concerned by the different land users - Managers of water and waste - Actors working on natural risks - Tourism organisations - Public authorities (e.g. for funding) - Networks of actors settled to develop regulations for land management - Organizations promoting wellbeing activities 	Mountains cross over very different contexts/challenges (valley/plateau, with or without agricultural activity, ...) <ul style="list-style-type: none"> - Activities are very different according to the seasons, as well as the stakeholders - Not just focus on tourist areas

	use) of activities in mountain territories. - Nature-based solutions as baseline approach	- Develop regulations for land management based on the cooperation between most of the actors		
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▪ **Initial consideration regarding LLs in Forest**

Table 8: First identification of what needs to be specifically considered regarding forests. We present here the result of 3 workshops of collective design. Forest can be seen as “mixed” areas, areas with specific soil use as agricultural lands, and natural areas, in which the combination between public and private goods and concern is particularly intricate. The features mentioned in table 8 are sources of reflexion for improving the impact on soil health of LL developed in other areas than forests

Aim	Activities	Participants	Context
Strategic orientation of the activities and bring the interest of more scientific research, more diverse disciplines for such areas - Foster conservation, avoid exploitation, or if necessary, focus on areas where it is less harmful to the environment, change land use if it makes sense - Increase and safeguard biodiversity within the ecosystem	Develop mediation between different interests (conservation vs. exploitation) → sustainable combination is possible, look at the soil as an integral part - Dialogue with stakeholders and forest farmers to identify how to address local problems and needs through sustainable approaches that consider bioeconomy and new policy directives - Test/Demonstrate/Boost (somehow) the potential of the forest for bioeconomy extension (bio-products)	Private land owners (who might not be users) and the users who are not land owners (logging companies, hunters and rangers...)	Diversity of management, stakeholders, use... between public and private forests is to be considered deeply

Conclusions

The conceptual framework designed to infer the potential of LLs to improve European soil health, comprises 4 blocks:

- A model of change which can be seen as a common horizon regardless of the soil use, the local situation in which soil health is to be improved, or the local regulation. It fits to the challenge of a pan European perspective for the 2030 achievements and orientations to act at the international level.
- The generic features of LLs for soil health, which should be found in any initiative regardless of the soil use; in addition to supporting the co-design activities, the networking of actors and the redesign of the value chains for the coherent transformation of practices, economy, regulations, public concerns...
- The differential features of LL for soil health in areas with specific land use, i.e. agricultural lands, cities, industrial lands and brownfields. For each, specific aims, activities, types of participants and contexts were described. They are core elements helpful to design new LLs or to orient existing ones towards improving soil health. They help frame the orchestration between the many stakeholders and discrepant concerns, and ensure the connectedness between similar or complementary initiatives. The features are foreseen to be enriched and evolve thanks to the sharing of experience and practice among the actors.
- The potential features of LL for soil health in natural areas and forests, the latter being considered as areas of mixed land use. These are initial considerations that can be used to design new generations of LLs, in which the combination between public and private concerns is particularly intricate and for which mitigating the impact of climate change is the major aim. As such, they could be exemplary for continuously improving the impact of LLs designed for a specific land use.

This framework combines scientific, political and practical knowledge to offer a common horizon and fertile background for local actions and initiatives that can be bound to accelerate the expected transformation. Its multi-dimensionality responds to the request of adopting holistic and open approaches for co-designing proposals. It provides the background needed to bring stakeholders around the table for designing soil health LLs. Therefore, in addition to this deliverable, we developed material (a kit) to run workshops in this perspective.

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- CSA ALL-Ready, <https://cordis.europa.eu/project/id/101000349>
- SMS project
- The Agroecology Criteria Tool. 2020. <https://www.agroecology-pool.org>
- European Network of Living Labs ENOLL: <https://enoll.org/>
- ENOLL tips and tricks for LL
 - <https://enoll.org/projects/>
 - https://enoll.org/wp-content/uploads/2017/07/finalcards_tt_print-1.pdf
- ENOLL membership application guideline for LL: assessment criteria
 - <https://issuu.com/enoll/docs/397044439-enoll-application-guidelines-13th-wave>
- NWO call on living labs: [Living Labs in the Dutch Delta \(LLDD\) | NWO](#), [Living Labs in the Dutch Delta | NWO](#)
- Territoires d'Innovation
- The living lab initiative AAFC
- RVO website: <https://infographics.rvo.nl/livinglabs/#>