HuMUS
Healthy Municipal Soils

Overview of best practices in sustainable soil management and soil health promotion

Deliverable D1.5

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Executive Summary

Soil health depends on soil management. This deliverable provides an overview of stakeholder perspectives on soil management practices, including their current and possible acceptance and estimated potential. A dynamic questionnaire on perspectives of several stakeholder groups (farmers and foresters, agricultural and forestal advisors, researchers, policymakers, non-governmental organisations) on soil health and associated soil management practices was distributed in 10 countries, receiving 154 answers. The most-mentioned challenges for maintaining soil health were **(1) Improve soil structure, (2) Maintain/increase Soil Organic Carbon, (3) Enhance nutrient use efficiency, (4) Enhance water storage capacity, (5) Enhance soil biodiversity, and (6) Avoid soil erosion**. Deviating perspectives between stakeholders could be explained by their different focus (e.g., practical, societal). The challenge of soil contamination was perceived as less important in northern countries than it was in southern and eastern countries.

In a second step, a set of soil management practices (SMPs) was evaluated for their effectiveness in addressing certain soil challenges and for their general feasibility. The SMPs with the highest multifunctionality (effectiveness against several important soil challenges) were **(1) Permanent soil cover, (2) Cover/catch crops, (3) Use of organic fertilisers, (4) Diversifying crop rotations, and (5) Including leguminous pastures in crop rotations.** The perspective on their feasibility was positive: While two of these SMPs (2, 3) were assessed as easily feasible by more than half of the participants (also amongst farmers), all others (1, 4, 5) were perceived as at least moderately feasible by 80 % of respondents.

When asked for their needs to implement further SMPs on their farm or in their region, farmers most often mentioned missing knowledge, while non-farmers demanded providence of machinery. Regarding municipal support, both groups preferred the provision of infrastructure (cooperatives, processing units, service providers, etc.) over regional governance actions (e.g., regional/municipal management agreements). Regarding policy measures, subsidies stay the most valued option.

Amongst the most important soil challenges, production-oriented and society-oriented ones could be found. As the challenges were strongly interrelated and often concerned similar functions of the soil, soil management practices can address both production- and society-related challenges. This is of importance when communicating soil health challenges and respective management strategies, as it is likely to increase acceptance among stakeholders: Productivity-oriented soil improvements may also impact societal functions, and vice versa.

The study linked perspectives on a wide range of soil health challenges with partly unspecific groups of soil management practices, thus, results should be handled with care. However, most of the drawn links between soil challenges and associated SMPs are supported by literature. Cover/catch cropping and the use of organic fertilisers were perceived as very effective and easily feasible and should be central when developing strategies for improving soil health—these two practices are already strongly recommended by EU and national legislation. Organic farming relies on three of the five

most multifunctional SMPs (3, 4, 5); its implementation can therefore be seen as a contribution to soil health overall (even though not all aspects are positive for all soil challenges). These practices are, however, not limited to organic farming, and their implementation in conventional farming should as well be further supported.

Other categories, such as maintaining a permanent soil cover, are relevant to a wide set of farm operations and are more a vision than a realistic management practice, indicated by a comparably low feasibility.

Apart from increasing nutrient efficiency (EU nitrate directive) and avoiding soil erosion (CAP conditionality), the other main soil challenges have by now not been addressed by the EU (although all of them are mentioned in the Soil Monitoring Directive under progress). However, most of the SMPs suitable to react on those challenges are addressed by the CAP. Future legislative approaches addressing soil health should therefore try to strengthen and disseminate existing and easily applicable practices, also by including knowledge transfer.

List of abbreviations

EU	European Union
GMO	Genetically modified organisms
NGO(s)	Non-Governmental Organisation(s)
SOC	Soil Organic Carbon
SMP	Soil Management Practice

1 Introduction

1.1 Soil health in current European policy

Soil health has been recognised as the fundament of the transition towards a sustainable and resilient agricultural production system. Beyond agricultural productivity, soil health embraces the integrity of soil ecosystem services (Lehmann et al., 2020). However, a growing body of recent literature highlights that soils are—at a global scale—experiencing soil degradation (Montgomery, 2023). The resulting decline in soil health has far-reaching consequences for the environment and human well-being.

The primary drivers behind the deterioration of soil health can be attributed predominantly to human activities, particularly related to urbanisation, land-use changes, and agricultural practices (Montgomery, 2023). Prăvălie (2021) found the main degradation pathways to be aridity, land erosion by water, salinization, soil organic carbon (SOC) loss, and vegetation degradation—most of them of anthropogenic origin.

Decades of unsustainable land management have led to the current situation that the majority of European soils are in an unhealthy state (European Commission. Directorate General for Research and Innovation., 2020). Although various policies regulate aspects of soil health directly and indirectly, a comprehensive legal instrument for soil protection is still missing in the European Union (EU) (Buratti-Donham et al., 2024, Heuser, 2022). Recently, efforts have been made to strengthen soil health policy at the European level by introducing the EU Soil Strategy and related legal changes (e.g., the Soil Monitoring Directive) (European Commission, 2021, 2023).

1.2 Soil health and soil management practices

Soil health is critically influenced by soil management; approaches for sustainable soil management are therefore at the core of the Common Agricultural Policy and of current EU strategies (EU Science Hub, 2023). However, maintaining soil health is not limited to these agricultural or forestal approaches, as it must also rely on governmental and policy action, e.g., regarding pollution, nutrient cycling, or soil sealing. These policy aspects are addressed in the HuMUS project in deliverable D1.4 (“Compendium of soil health policies in selected partner countries”).

As agricultural and forest soils cover the greatest area of the European Union and can be addressed most directly via the Common Agricultural Policy, the focus of this deliverable lies on these soils. Management practices, involved stakeholders, and legislation would have been fundamentally different for other soil types.

Agricultural and forest soil management practices are very diverse: they address mechanical work (e.g., machine weights and traffic, tillage), cropping (e.g., selection and diversity of species on the field and over time, soil cover), fertilisation and irrigation practices, amongst others. The sustainability of a combination of these management practice dimensions cannot be evaluated generally but must be suitable for the site- and farm-specific requirements. Single management practices can be grouped (e.g., conservation tillage, containing all practices that do not use ploughing but still practice tillage), and there have been various studies evaluating their effect on single soil health parameters.

1.3 Soil management practices and social sciences

For reaching the EU's goal of strengthening the transition towards healthy soils (Directorate-General for Agriculture and Rural Development [DG AGRI], 2023), approaches are needed not only from the life sciences—raising people's awareness for soil health issues is crucial for long-term embedding in society and policy. The European Commission has recognised this by focusing the research and innovation programme within the Soil Mission (which also funded the HuMUS project) on social sciences. Current efforts on soil health policies are valuable and should lead to a profound and effective integration of soil protection into European legislation. To enhance the efficiency of their implementation, it is important how different groups of stakeholders look at soil health, its related needs, and solutions. Differing assessments of the importance of a soil threat or of the effectiveness of a management method necessitates exchange between stakeholder groups, and stakeholders sharing some priorities could join forces. This deliverable does not add to the diversity of sustainability evaluations of different soil management practices, rather, it focuses on the perspective of the affected stakeholder groups.

Therefore, the core of this deliverable is the data from a questionnaire where different types of stakeholders were asked for their opinion on the most important soil challenges in their region and related soil management practices to address these challenges. These perspectives could be helpful to get a more differentiated, stakeholder-specific view on management practices, including their current and possible acceptance and estimated potential. **This study should therefore not be interpreted as an expert review on the mentioned topics but as a contribution for estimating the acceptance and integration of measures strengthening specific soil management practices.**

2 Methodology of the questionnaire

2.1 Structure and content

The Chamber of Agriculture North-Rhine Westphalia (LWK NRW) and the University of Gastronomic Sciences, Pollenzo (UNISG) developed a combined online questionnaire for deliverables D1.4 and D1.5 on soil health policies and management practices, respectively, to avoid stakeholder fatigue of the various experts to be contacted during the project. Soil challenges and soil management practices (SMPs) had already been addressed in a survey conducted within the project "EJP Soil". Whereas this former survey focused on the perspective of researchers (Paz et al., 2023), the herein presented questionnaire was targeting a broader group of stakeholders (farmers and foresters, agricultural and forestal advisors, policymakers, researchers, NGOs). However, the overall study design of Paz et al. (2023) was considered suitable and adopted accordingly. Corresponding questions were adapted to a more diverse group of stakeholders. Furthermore, additional questions focusing on farmers and a part on related policies were added. For forest soils, the discussed SMPs differed from those for agricultural soils; they were sourced from United States Department of Agriculture (2021) and supplemented with additional practices. The structure and all contents of the questionnaire that will be outlined shortly in this section can be found in Annex A.

The first part of the survey contained personal and demographic information about the participants, such as education, stakeholder group, working country, and work experience. Stakeholders identified as farmers and foresters or agricultural and forestal advisors were asked for more specific information about farm specialisation and size of their own or their clients' farms.

The opening question of the following section (Q11) dealt with the main three soil challenges of stakeholders' regions that could be selected from a list of eleven. The identified main soil challenges were central for the later, personalised questions. For farmers, foresters, and advisors, the following block of questions (Q12-Q19) first asked for existing, then for further possible soil health management practices on farm. For both groups, questions then enquired about already existing or additionally required support on several levels.

A list of soil management practices (adopted from Paz et al., 2023, as described above) was provided, and their effectiveness against each of three previously identified, regionally most important soil challenges was assessed in a three-step categorical manner: not effective, moderately effective, very effective. All soil management practices that were assessed as at least moderately effective in handling a soil challenge were transferred to the subsequent question, asking for an estimation of its feasibility (not feasible, moderately feasible, easily feasible). The selection of soil management practices to be assessed was different for stakeholders associated with either agricultural or forest soils.

The concluding part of the questionnaire asked for further implications on policy improvements, the use of participatory processes in soil health management, and further known actors in the field of soil health (network-building, distribution of the questionnaire).

2.2 Implementation and dissemination

The questionnaire was built with the online tool Qualtrics™ XM (Qualtrics, Provo, USA). It was designed in a branch structure, so depending on the stakeholder group, specific

questions were excluded. This structure is also depicted in Annex A. All questions were translated to the languages of the project partners (Albanian, Bulgarian, German, French, Italian, Macedonian, Dutch, Serbian, Slovenian, and Spanish) by auto-translate and a subsequent correction in a collaborative process with the respective partner organisations.

The questionnaire was open between 7 July 2023 and 19 September 2023. The HuMUS project partners were asked to disseminate the questionnaire amongst their regional stakeholders, aiming at 5 participants per group (farmer and forester, agricultural or /forestal advisor, policymaker, researcher, NGO) and region. As dissemination was delayed in some countries due to the summer break, the planned answering time of two months was exceeded slightly.

Project partners were asked to select the contacted stakeholders based on the following criteria (Table 1):

Table 1: Criteria for selecting participants for the online questionnaire.

Stakeholders	Description
Farmers	• at least 5 years of experience in organic and/or biodynamic agriculture and/or agroecological practices, or: • at least 5 years of experience in conventional farming practicing regenerative agriculture
Foresters	• manager of public forest, • or of a farm's forest area used for wood production
Advisors	• at least 3 years of experience/information support related to soil health, organic agriculture, agroecological transition, or related topics
Policymakers	• at least 3 years of experience related to soil health at the regional level, organic agriculture, agroecological transition, or related topics
Researchers	• at least 3 years of experience in research related to natural science
NGOs	• at least 3 years of experience in work with stakeholders that use organic agriculture or conventional farmers with practices of regenerative agriculture

2.3 Data management and evaluation

Data management was prepared online using the built-in Qualtrics tool, and data was cleaned using Microsoft Excel 2016 (Microsoft Corporation, 2016). The clean evaluation sheet was imported into R (RStudio Team, 2022), where all subsequent graphical evaluations were processed.

As there were very few answers from foresters, not all questions could be evaluated, especially questions 22 and 23 (see Chapter 8.1) were not valid for evaluation. North Macedonia partners received many answers, including some from neighbouring Balkan

countries. As those were too few to evaluate them by country, they are grouped as “North Macedonia & other Balkan countries”.

3 Conclusion

We have lined out the perspectives of five different stakeholder groups on major challenges of soil health and on the management practices that they attributed as effective and feasible to face those challenges.

Although all soil challenges have already been addressed elsewhere, the importance of soil structure may be remarkable. However, all soil management practices related to soil structure are well-known and widely established; many of them are already part of national or EU legislation, or CAP/GAEC regulations. Thus, the main challenge is not the establishment of new methods or technical solutions but the further dissemination and distribution of already established methods and the increase of their effectiveness. One strategy for this has been outlined at the European level as lighthouses and living labs. We need to find out what prevents the adaptation of well-known SMPs in a certain region and by certain stakeholders and find specific solutions on site.

The collected data could not only have been evaluated by country or stakeholder but also by region, production, and other social factors that were included in the questionnaire. This would have exceeded the scope of this deliverable, but the authors are open to sharing the collected data for further evaluation.

4 Acknowledgements

Although the report was written mainly by Daniel Gärttling and Dr. Konrad Egenolf, the creation of the content was an example of teamwork. Natalia Rastorgueva and Jessica Buratti-Donham of the University of Gastronomic Sciences, Pollenzo co-created the structure of the questionnaire, provided valuable advice in many cases and also the technical infrastructure for the online implementation—let alone Natalia's competence to keep an eye on the overall schedule.

During the conception of the questionnaire, our colleague Carlos Angulo (LWK NRW) provided advice from his profound experience in designing questionnaires—without him, the questionnaire would have been much longer and less stringent.

Designing a questionnaire that should later be available in eleven European languages was ambitious and would not have been possible without the eager and fast work of our colleagues in the HuMUS consortium: Ascención Circuelos (CTAEX), Merel Hondebrink and Janus den Tonder (Louis Bolk Instituut), Rocío Iglesias (AGAPA), Darko Konjevic (SWG RRD), Tanja Mimmo (UNIBZ), Brina Novak (Regionalna razvojna agencija za Podravje), Irene Palomino (FUNDECYT-PCTEX), and Laura Perez (CAPDL). They not only gave feedback on the questionnaire structure and contents but also translated it and distributed it to the variety of different stakeholders—shortly, they ensured the success of having so many and such diverse answers for evaluation. There is, of course, much "hidden" work in this delivery, such as the coordination tasks that were perfectly executed by Annalaura Vannuccini (ANCI Toscana), further distribution of the questionnaire, proofreading, translations, etc.—hence, a special thanks to all in the background!

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