



EU MISSIONS

SOIL DEAL FOR EUROPE

**Social sciences, humanities,
and the arts in the EU Mission
“A Soil Deal for Europe”**

Review and recommendations from
Mission Soil Board

12 December 2024

**Independent
Expert
Report**

*Research and
Innovation*

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Aims of the document

The aims of this document are to:

- enhance the understanding of the relevance of social sciences, humanities, and the arts (SSHA) in soil research;
- review the integration of SSHA in the work of the Horizon Europe Mission ‘A Soil Deal for Europe’ to date;
- provide recommendations on strengthening the integration of social sciences, humanities, and the arts in future research under the Horizon Europe Mission ‘A Soil Deal for Europe’.

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Executive summary

Social sciences, humanities and the arts (SSHA) are indispensable in delivering the objectives of the Mission “A Soil Deal for Europe” (hereafter Mission Soil). The Mission Soil aims for a rapid improvement of the condition of soils in Europe and elsewhere. This implies deep societal change at a range of scales. Therefore, achieving its ambition entails a profound involvement and investment in the Mission of social sciences, humanities, and the arts (SSHA).

We recognise the importance of both discipline-specific SSHA research, and of the integration of SSHA within natural sciences and engineering, to the achievement of the objectives of the Mission Soil.

This should include greater investment in SSHA as part of Mission Soil. We urge all actors involved in the creation and programming of the work of the Mission Soil to incorporate SSHA as a requirement in more if not all proposals under the future Work Programmes. We also urge these actors to ensure that research calls which aim to understand and/or transform social relations with soils, *in any aspect*ⁱ, be written in close consultation with SSHA experts, and that SSHA experts are present on evaluation panels (leading them when appropriate).

We recommend that the Commission assembles an expert group to set a list of key SSHA research questions for soils research and pathways of transition to soil health, and that it includes more SSHA experts, especially with interdisciplinary and transdisciplinary expertise, in its Mission Board.ⁱⁱ

We urge all actors involved in the creation and programming of the work of the Mission Soil, whose outcomes are foundational to the future of European and other societies and environments, to lead the way in the true integration of SSHA.

Soil change and social change are inseparable – by working on these together, the Mission Soil will ensure the achievement of its objectives.

Introduction

1.0 Incorporation of social sciences, humanities, and the arts is crucial to the achievement of the objectives of the Mission Soil

The main objective of the Mission Soil is to achieve significant improvement in the state of soils. Social transformation of relations with soils is, in the opinion of the Board, a condition for the achievement of this objective (including in its cultural, economic, and political dimensions).

Maintaining and restoring soil health is a major and long-term endeavour. It requires transformative changes in practices by all sectors of society, across all types of land uses and scales in a joined-up manner.

EU Mission Soil Deal for Europe: Implementation planⁱⁱⁱ

Soil protection and restoration need to be embedded in all human activities that have an impact on land.

Mission Soil Manifesto^{iv}

In this, the Mission Board recognizes that social and environmental processes are deeply intertwined. Consequently, in our view achieving the Mission Soil objectives requires that **equal effort be dedicated to research on social change and to research on environmental change, and that these two should be integrated.**

This entails a profound involvement of and investment in social sciences, humanities, and the arts (SSHA) in generating fundamental knowledge on current patterns of thought and (in)action in relation to soils, and the possibilities for their change, and in leading the co-design of research questions, methods, and outcomes of transdisciplinary research. The transdisciplinary aspect is particularly relevant to Living Labs, which are the main instrument of the Mission Soil and whose design integrates SSHA and natural sciences within a real-world context.

This approach is consistent with, although also goes beyond, the trajectory for the integration of social sciences and the humanities (SSH)^v into Horizon programs, first set out in relation to Horizon 2020, and continued under Horizon Europe.

The integration of SSH in all Horizon Europe clusters, including missions and partnerships, is defined as a key cross-cutting priority. Effective SSH integration represents is considered an important requirement for fostering societal impact in the future.

Integration of social sciences and humanities in Horizon 2020^{vi}

We observe that the engagement with SSHA continues to be largely dominated by the knowledge deficit model, in which problem framings are developed within the natural sciences and SSHA are mainly tasked with societal engagement with those framings.

Instead, we urge for a recognition that **SSHA research has fundamental value in broadening the scope of research questions on human-soil interactions.**

SSHA are indispensable in delivering the objectives of the Mission, as **acting on soils necessarily intersects complex and interconnected social and environmental problems.** Overall, we recognise the importance of both discipline-specific SSHA research for advancing state-of-the-art soil research in respective SSHA disciplines^{vii}, and the importance of the integration of SSHA within natural sciences and engineering, as set out in the Horizon Europe Strategic Plan.^{viii}

We wish to see improvement in the **integration of SSHA into future EU framework programmes for research and innovation**, as called for by the *Integration of social sciences and humanities in Horizon 2020* report, and by the extensive work by the European Alliance for Social Sciences and Humanities (EASSH). While positive trends are observed, such as SSH topic ‘flagging’, further improvement is urgently needed to ensure SSHA do not participate in a tokenistic manner, and that their potential is maximised. The Mission Soil, whose outcomes are so foundational to the future of European and other societies, should lead the way in the true integration of SSHA into Horizon activities. We agree with EASSH that

Claims that the work of the Missions will be embedded in social and cultural contexts are empty without structures that can understand the type of research needed to achieve this aim, where this research is produced and developed, and how to recruit leading researchers to participate.

EASSH, SSH Integration in Horizon Europe and its Missions^{ix}

The integration of a social sciences expert in the Mission Board of the Mission Soil, and the creation of a Working Group dedicated to SSHA in the Mission Soil, are certainly a positive step towards addressing these structural issues.

In the rest of this document we, firstly, briefly introduce social sciences and humanities and the arts, and the relevance of their integration in relation to 1) generating fundamental knowledge about social relations with soils, and their change, and 2) leading transdisciplinary research on soils. We offer recommendations for action to strengthen the contribution of SSHA to both these areas of the Mission’s activities. In the Additional Material, we briefly review the previous Mission Soil Work Programmes in line with the methodology for flagging SSH relevant topics in Horizon 2020, and offers suggestions for how SSHA can be better included in future programmes.

2.0 What does research in social sciences, humanities, and the arts look like?

2.1 Research within SSHA disciplines

Scholars in social sciences, humanities, and arts **study social relations, in all their aspects**. They do this by focusing on various areas and scales of social action, organisation and influences. Sometimes they study individual behaviour. More typically, they study collective behaviours, including belief systems, institutions, languages, and many other areas of social action. These are studied at multiple levels (household, farm, institution, knowledge community, nation, etc.).

As a result, SSHA investigations give rise to different questions than do the natural and engineering and planning sciences.

SSH encompass a wide range of disciplines such as sociology and economics, psychology and political science, history and cultural sciences, law and ethics. Contributions from these research fields are needed to generate new knowledge, support evidence-based policymaking, develop key competences and produce interdisciplinary solutions to both societal and technological issues. SSH give EU citizens a unique opportunity to understand their past, current and future environment, and to propose answers to complex and challenging questions.

Integrating social sciences and humanities across Horizon 2020*

SSHA produce robust knowledge by collecting qualitative data, through e.g. interviews, observations, and analysis of texts (both visual, material, and written), as well as practice-based methods. They also use quantitative data, through e.g. surveys, modelling or analysis of secondary (e.g. administrative, demographic) data, including quantitative analysis of texts, or analysis of demographic patterns. The data is analysed in light of different theories. The arts, especially artistic and design research, rely on sensory, participatory, spatial, digital, and performative methods in addition to collecting qualitative data to investigate human-nature relations.

The findings or outcomes of research present **insights on what is happening in society** (e.g. this is what this group of people reported feeling when asked this specific question in this specific context; this is the range of behaviours and beliefs/attitudes that have been observed in this specific place and time in relation to this specific issue). They also provide **understanding of structural factors informing action and (in)action in society**, including economic power, governance, institutions, legal arrangements (e.g., about access to and ownership of land) etc.

The findings (or outcomes) also present **hypotheses about why certain things are happening, or are not happening**. For example, they may offer insights on what societal, technological, political, organisational path dependencies need to be considered for achieving sustainable changes, or for solving problems effectively and in a just way.

Sometimes, especially in the humanities and in the arts, the research results **speculate alternative futures or propose new ways of thinking or behaving** (these propositions may be represented as text, as concepts, as visuals or other materials, or as performances). In other contexts, e.g. theoretical economics, the research outcome may be a **theoretical model** that offers hypotheses, which are later verified by means of empirical analyses or (simulation) modelling.

Example 1: Understanding multiple values around soils in New Zealand.

Problem framing: Managing soils sustainably requires an understanding of the core values people hold about soil and soil health. However, there is a limited understanding of what these values are for soil beyond some of their instrumental values.

Approach and methodology: This study uses the Nature Futures Framework (NFF) to understand the role of instrumental (i.e. what nature does for us), intrinsic (protecting nature for nature's sake), and relational (multiple ways people value nature and the benefits they derive from it) soil values. 26 semi-structured interviews were undertaken with 26 people from across Aotearoa New Zealand with a strong connection to the agricultural sectors. NFF was used to guide the thematic analysis of the interviews.

Key findings and ways forward: It is found that people employ multiple values around soils and soil health. Therefore, policy frameworks need to incorporate these multiple values, including indigenous ones. A multidimensional framework for valuing soils within policy is proposed which aligns Māori knowledge and perspectives with Western-centric perspectives to incorporate a range of values from people with diverse backgrounds that can embrace other knowledge systems, values, and perspectives.

Source: Stronge, D.C., Kannemeyer, R.L., Harmsworth, G.R. et al. Achieving soil health in Aotearoa New Zealand through a pluralistic values-based framework: mauri ora ki te whenua, mauri ora ki te tangata. *Sustain Sci* (2023). <https://doi.org/10.1007/s11625-022-01269-x>

Example 2: Understanding the role of scientists in the success of voluntary soil conservation and improvement initiatives: the case of “4 per mille”.

Problem framing: The number of voluntary initiatives around soil health and soil protection is growing. They often involve scientists. To be effective, they need to engage a broad range of stakeholders. This study focuses on the role scientific experts play in these initiatives to assess their impact on the initiative's transformative ambitions. It focuses on “4 per mille” (4PM) as a case study.

Approach and methodology: This study uses theories from Science and Technology Studies to understand the role of scientists in shaping of 4PM and its activities. The data include participant observation in 4PM events, 19 semi-structured interviews with relevant stakeholders, and analysis of most reports and academic literature published on and by 4PM (date range 2015-2020).

Key findings and ways forward: The key role of scientists in 4PM, and the use of technical and scientific language, have increased its credibility amongst stakeholders. At the same time, because of the lack of integration of socioeconomic aspects of the land use transition, 4PM did not manage to enrol large emitting countries or civil society organisations representative of peasant and familial agriculture.

Source: Aubert, P. M., Ruat, R., Treyer, S., & Rankovic, A. (2020). Holding the ground. Alliances and defiances between scientists, policy-makers and civil society in the development of a voluntary initiative, the “4 per 1000: Soils for food security and climate”. *Environmental Science & Policy*, 113, 80-87.

As in natural sciences, social science, humanities, and arts scholars tend to be **experts in specific objects of research within their disciplines**. These objects of research are arenas of social action, such as education, food systems, environmental conservation, healthcare, etc. SSHA scholars on the one hand have specific geographical and historical areas of expertise, for example, agriculture in the modern period in the UK, environmental conflict in colonial Ghana, governance of pollution in post-war Korea, etc. On the other hand, they may develop theories that tend to large scale and even global phenomena, for example in Anthropocene studies.

In relation to soils and the environment more broadly, **SSHA research investigates the relationship between patterns of action and thought and environmental change** (including both degradation and restoration). This includes for example understanding the history of human-soil and human-land relations in specific places, understanding the impact of particular governance systems on land management practices, understanding the cultures and ethics of land relations within and across different communities, and many others. These understandings are developed in relation to specific groups of people, historical periods, and geographies, and their cultures, politics, economic systems, etc. This **context-specific perspective is particular strength of SSHA** which can contribute to the achievement of Mission Soil’s objectives.

Thus, SSHA can offer significant contributions to soil research, including^{xi}:

- Knowledge of the history of innovations, places, and relations, which is relevant to the understanding of their present and future (especially with regards to societal values around innovations);
- Understanding of how social, economic, cultural, environmental and political contexts shape soil-related knowledge and innovation, including unspoken cultural assumptions, socioeconomic relations, and ways of knowing – including how these shape soil-related research projects themselves;
- Methodological expertise in the study of land workers and other societal actors’ values and needs;
- Methods and approaches which result in meaningful forms of public engagement, especially the incorporation of societal critique early on to prevent mis-alignment of innovation, or public controversy;
- Insights into how to improve research and funding policies and practices.

In comparison to environmental natural sciences and engineering, **environmental SSHA research is severely underfunded**: a recent study in 37 countries reports that natural sciences receive on average 770% more funding than social sciences and humanities to research environmental change.^{xii} Further, across SSHA disciplines, soil is a relatively new research topic. As a result, there are fundamental knowledge gaps in SSHA on understanding human-soil relations, both historically and contemporarily, and in different geographical contexts. This understanding is crucial to any effort to transform the current relation to soil and make sustainable the human use of soil, and more targeted funding is needed to bring the topic of soil up in the agenda of SSHA.

2.2 SSHA in transdisciplinary research

SSHA have been **increasingly playing a key role in transdisciplinary research**, that is research which adopts a co-production of knowledge approach between academia and the wider society. Transdisciplinary research is growing in importance because it is now understood that the linear model of social change based on science communication does not work.^{xiii} Communicating the findings of natural scientific research to people, including relatively powerful groups, such as policymakers, in itself does not produce social change. Change takes place when new knowledge becomes part of new patterns of behaviour. This may include new cultural narratives, models of best practice, livelihood models, formal and informal institutions and modes of governance, and many others. To develop such change-oriented learning, **experimentation with different transdisciplinary research methods and approaches is needed**. **SSHA have led the way** in developing methodologies and tools which gather heterogenous knowledge about situations, help

understand conflicts, and experiment with collaborative ways forward (including participatory action research, co-production of knowledge, citizen dialogues, and many others).^{xiv}

In recognition of this, the Mission Soil has a strong focus on transdisciplinary research, especially through embedding research activities within Living Labs and Lighthouses.

The mission will be carried out through 1) an ambitious cross-scale, inter and transdisciplinary R&I programme with a strong social science component to fill knowledge gaps and develop solutions for soil health and the provision of ecosystems services (...) 2) an effective network of 100 living laboratories (LLs, for experimentation) and lighthouses (LHs, for demonstration of solutions) across rural and urban areas to accelerate the cocreation and uptake of solutions across farms, forest, natural landscapes and urban settings in a diversity of geographical and socio-economic context.

Mission Soil Deal for Europe Implementation Plan^{xv}

LLs are open innovation arrangements which activities are organised based on a fundamental principle: co-creation with users in real life conditions.

Mission Soil Board's view on Soil Health Living Labs under Horizon Europe^{xvi}

SSHA are well placed to lead transdisciplinary research. In transdisciplinary research, engaging the wider society at all stages of knowledge production (from research questions to application of findings) is central. SSHA are well placed to lead this work, as **understanding the concerns of social groups and designing methodologies for addressing these concerns requires SSHA expertise.**

Transdisciplinary research methods or approaches also require certain competencies, such as self-reflection, collaboration skills, situational skills, conflict awareness, etc., which are currently not trained in academic institutions and are thus often missing to make collaborations work. Often it is assumed that SSHA researchers in the collaboration take over the work of organizing integration and bringing in transdisciplinarity competencies- This can be to the detriment of the SSHA research as it places SSHA in a ‘service’ role rather than as an equal partner in setting research questions, project design and methodology, and contributor to knowledge.^{xvii} Moreover, programs typically do not recognise the time needed for developing transdisciplinarity.

It is therefore important to recognise that supporting transdisciplinarity requires both changing the structure of funding calls, adjusting expectations around timelines, and dedicating funding for specialist personnel that is specifically dedicated to organizing integration of and dialogue between perspectives, approaches, knowledge and perspectives. This can either be a scientist taking part in the collaboration or an expert facilitator.^{xviii}

LLs should also be seen as objects of research for SSHA, as understanding LLs processes will be essential for the success of the Mission Soil. This may include focusing on topics such as modes of engagement, building paths for green economies, social empowerment, social innovation, modes of mediation, knowledge interactions and integration, co-decision processes, mixed models of governance, and many others.

3.0 Recommendations

The recommendations focus both on the need to support fundamental SSHA soil research, and to ensure a robust transdisciplinary approach in the Mission Soil.

In line with the previous recommendations by EASSH, we urge all actors involved in the creation and programming of the work of the Mission Soil to integrate SSHA expertise in work programme design, call text writing, advisory and expert work, proposal evaluation panels, and project and programme evaluation.^{xix}

3.1 The need to fund fundamental, disciplinary and interdisciplinary SSHA research on soils.

To achieve its objectives, we recommend that in the Mission Soil the full involvement of the SSHA disciplines is promoted, that the interface between SSHA and the other sciences be strengthened, and that the need to generate new, fundamental SSHA knowledge be acknowledged and supported. Appropriate Mission actors should monitor and assess the development of SSHA research under its remit.

Areas of fundamental disciplinary and interdisciplinary SSHA knowledge of high relevance to the Mission include, but are not limited to:

- Research on the role of structural conditions, such access to land, structures of financing, legislative and economic models in soil health-impacting sectors, etc. on the shaping of human-soil relations, including modes of change and lock-in breakout;
- Research on what the enabling conditions are for improving and maintaining soil health, including structural conditions, cultural models and narratives, livelihood solutions, models of effective collective action, and others, in different sectors and cultural and geographical contexts;
- Research how different land-working groups use and adapt techno-scientific approaches and products (including those used in agriculture and forestry, infrastructural work, urban planning, hydrological management, waste disposal and management, and others), the impacts of those on soil health outcomes, identification and understanding of negative or limiting socio-technical path dependencies and suggestions for change, including through co-development of novel approaches with relevant social groups;
- Research on how existing patterns of thought and action may be shifted to drive improvement, including studying already existing examples of good soil relations, studying how good relations may be created elsewhere, and experimentation with news ways of thinking and acting in relation to soils;
- Research on the importance affective (emotions-related) relations with soils on foresting soil health oriented action and attitudes, for example investigating how to support positive affects around urban soils, or the role of experiential learning for the creation of positive soil affects in land working populations;
- Research on embedding achieving and protecting soil health as a value within responsible research and innovation across sectors;
- Research on knowledge production, mediation and communication mechanisms which lead to socially just change while achieving soil health outcomes, including the role of citizen-led knowledge production, alternative (not scientific) forms of knowledge representations, and the importance of emotion and affect;
- Research forms of soil health monitoring approaches and technologies which produce socially actionable knowledge for use at different scales of decision-making (from international policy to field-scale);

- Research on the impacts of existing policies and legislative instruments in different sectors on soil health outcomes, such as ‘the polluter pays’ principle; and research on new designs of policies and legislative instruments for soil health
- Research on cultural norms around soil relations, their impacts on soil health, and possibilities for their change through bottom-up cultural practice (e.g. norms around being ‘a good farmer’);
- Research on the role of multi-actor constellations (e.g. along value chains) and the leverage points (including policies, business models, value shifts etc.) to transform soil–human relations; research on new governance schemes
- Research on path dependencies/lock-ins/undesirable resilience in unsustainable human–soil relations;
- Research on new economic and financial theories and models which support social and ecological justice, the green economy, and sustainable livelihoods;
- Research on the transferability of insights from behavioural sciences on the importance of heuristics and biases, social networks, habits, social identities etc. to the context of human–soil relations;
- Research on co-creation and co-design processes for adaptation between human needs and non-human environments with a focus on soils;
- Research on landscape-level understandings for social transformation to underpin soil health;
- Research on the effectiveness of LLs, and on how to scale LL approaches to maximise socially and environmentally just outcomes;
- Research on how data is gathered and how impacts are monitored in relation to diverse soil related activities, within specific sectors or policy areas as well as across these, the evaluation of existing procedures (or lack of thereof), and suggestions for achieving improved outcomes. Research on user driven digital design.

3.2 The need to support robust transdisciplinarity.

It is crucial that **transdisciplinary research funded by the Mission experiments with different approaches, engages a large diversity of social groups, and works at different scales.** This means supporting the adoption of a variety of research framings (for example, avoiding the dominance of the research framings from economic and behavioural sciences over the framings from other SSHA disciplines such as human geography, law, politics, history, etc.). It also means opening up the understandings and valuation of research beyond discipline-specific and academia-focused metrics, and understanding innovation beyond a linear model.

Transdisciplinary research design within the Mission Soil must **provide funding mechanisms to ensure the participation of a range of actors.** Many important players operate outside academia or other formal institutions; it must be possible to account for their participation in funding mechanisms. Communities engaged in transdisciplinary research must go beyond policymakers, corporations, or the main sectoral organisations (e.g. national foresters’ or farmers’ unions).

The funding structures must also recognise the **time investment and output flexibility which are needed for transdisciplinarity** development. Funding mechanisms should evolve to support the co-innovation process, including flexibility around outcomes (which are more difficult to be foreseen), as well as adaptation, evolution, and emergence as part of project development.

Funding needs to be structured in such a way that working with NGOs, loosely organized farming groups, museums and art spaces, DIY and design labs, online groups and networks, schools, community groups, and others be legally and fairly included and supported as equal partners in transdisciplinary research. This

multiplicity of scales of investigation and action is crucial: different participant groups will develop different questions related to soil change and social change, and so offer different opportunities to act.

The Living Labs (LL) are one of the main instruments of the implementation of Mission Soil. **It is essential that Living Labs are built around issues identified by societal groups, and that their research methods are co-designed, and research carried out in full collaboration with those groups.** Pre-funding mechanisms to support the development of LL consortia should be considered to prevent privileging a narrow group of well-networked research organisations and to enable inclusion of a variety of social groups. SSHA expertise, and in particular the expertise of the transdisciplinary researchers, as integration experts, is essential in building LL consortia in the pre-funding stage, and in delivering LL co-production research. SSHA should also lead research on how LLs work in practice, and how LL approaches can be scaled.

In summary, it is crucial that in the Mission Soil:

- A range of SSHA disciplines are integrated into and have the opportunity to lead transdisciplinary research;
- There is a wide geographic, socio-demographic, and socio-economic range in the kinds of societal groups brought into the research;
- Funding enables research participants to be recompensed for their time and contribution in a just way;
- Funding is adapted to the characteristics of co-creation processes, including recognition of different time scales and flexibility of methods, outputs, and structures. This could include adaptability of the research framework and flexibility and/or change around deliverables (recognising that co-creation between disciplines and stakeholders will result in changes to initially proposed methodologies, approaches, and outputs; it is therefore necessary to give for the pre-agreements made at proposal submission stage to develop); recognition of the additional time investment needed at the start of the project to develop functioning trans-disciplinary working relation and protocols; acceptability of a variety of output formats, including reports, practices, video materials, or testimonials.
- The integration of SSHA in the transdisciplinary research, including in LL processes should be monitored and assessed throughout the duration of the Mission. This should include: ensuring that proposals which do not meet SSHA inclusion criteria are not funded; regular reporting from projects on SSHA integration; cross-learning on SSHA integration e.g. through the Mission Soil Platform facilitated events; tailoring of the subsequent Work Programs in light of the findings to e.g. target specific disciplines and approaches.

3.3 The need for expert engagement with the SSHA community

To ensure the achievement of its objectives, and to raise the profile of the Mission in the SSHA community, the actors involved in the creation and programming of the Mission Soil should assemble an expert group to set a list of key SSHA research questions for soils research and transdisciplinary research— while this document provides a starting point for this work, a more extensive reflection and involvement is needed. All actors involved in the creation and programming of the work of the Mission Soil should support the development of think tanks or foresight studies analysing the questions, gaps, and future topics of SSHA soil research, and support the development of a framework for SSHA research in the Mission Soil.

Crucially, **research areas and research questions** relating to work which aims to understand and/or transform social relations with soils must integrate SSHA framings and approaches. Evaluation of proposals must also include SSHA experts; natural scientists must not lead the evaluation of proposals within SSHA calls, and calls with SSHA components must include subject-appropriate SSHA experts in the evaluation panels. Panels should be developed to assess transdisciplinary research.

We recommend that further SSHA members are included in the Mission Soil Board.

The next Work Programme, and other activities of the Mission Soil, need to include SSHA in order to successfully deliver on the objectives of the Mission Soil. SSHA should be a requirement for each proposal under the future Work Programme. Without it, the required strategic goal of achieving 100% healthy soils by 2050 will likely not succeed.

Additional material

A review of the inclusion of social science, humanities, and artistic research in Horizon Europe Work Programmes

To illustrate how the integration of SSHA in Mission Soil activities could be improved, below we offer a brief assessment of the SSHA integration in the 2021-2022, 2022-2023 and 2023-2024 Work Programmes. We also suggest alternative research call wording which would make it more applicable to SSHA research. As noted in the assessment of Horizon Europe programs by EASSH, SSHA integration is ensured when key SSHA research questions are included in the development of the programmes.^{xx}

In the majority of cases, we find that **the calls currently follow the knowledge deficit model**: natural sciences identify and/or develop desirable solutions, and seek to communicate those to stakeholders, with some limited effort to understanding barriers to take-up (mainly limited to economic dimensions).

This approach is unlikely to achieve the objectives of Mission Soil.

Instead, the calls should include the **investigation of the social reality** which they seek to change, and **develop targeted solutions**: developing appropriate innovations which are co-designed with users; influencing key groups (identified as part of the research); targeting particular practices or sectors; empowering stakeholder for ongoing learning to underpin continued improvement, etc. An understanding of social realities and equitable cooperation with stakeholders will ensure the effectiveness of developed solutions.

Mission Soil calls in the Horizon Europe Work Programme 2023

HORIZON-MISS-2023-SOIL-01-01: Discovering the subsoil

Summary of desired outcomes: Improved access for land managers and public authorities to data and knowledge on subsoils; support the development of sustainable soil management practices as well as financial and policy incentives, and accelerate their deployment.

The need for SSHA expertise in achieving desired outcomes: **HIGH**.

Summary of proposed activities: increase knowledge of soil properties and their relation with ecosystem services; identify pressures; identify indicators of change; identify the potential for soil carbon maintenance and increase; identify, as develop and test sustainable management practices; develop and demonstrate tools and methods for risk assessment; improve monitoring methods.

The presence of SSHA approaches in proposed activities: **ABSENT**.

An example of SSHA led-activities within the call remit: understand why a focus on subsoils has been absent in land management debates and governance to date, with a focus on cultural, political, and economic drivers, and the history of soil sciences. Develop strategies for engaging land managers and public authorities with the knowledge on subsoils, including an understanding of the extent to which this engagement can transform land management practices. Reasons for the lack of knowledge on how current societal relations with and understandings of soils are influenced by past and current political, cultural, and governance structures.

HORIZON-MISS-2023-SOIL-01-02: Soil pollution processes – modelling and inclusion in advanced digital decision-support tools

Summary of desired outcomes: building the knowledge base for soil health and its support to ecosystems service; enhanced access to knowledge and uptake of sustainable soil management practices and restoration of polluted soils.

The need for SSHA expertise in achieving desired outcomes: **HIGH** in relation to knowledge access and practice uptake objectives.

Summary of proposed activities: improved monitoring and modelling; new knowledge development on pollution and soil processes; ensuring data interoperability; modelling of future scenarios.

The presence of SSHA approaches in proposed activities: **ABSENT**.

An example of SSHA led-activities within the call remit: incorporate participant-led or stakeholder-inclusive modelling to ensure that future scenarios are socially realistic, acceptable, and reflect basic values of social justice, and are able to respond to already present societal trends in land use. Develop and test citizen science approaches for monitoring soil pollutants.

An example of a social science and arts and humanities-led research focus for this area: understand the relationship between soil pollution and national, regional, and global governance of industrial or agricultural production chains.

HORIZON-MISS-2023-SOIL-01-03: Onsite digital technologies to monitor nutrients and chemical or biological stressors in soil and plants with relevance for food safety and nutrition.

Summary of desired outcomes: increased scale-up, availability and use of onsite digital tools for monitoring nutrients in plants and in food products; improved food safety mitigation

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: Advance and/or develop onsite digital technologies and applications for monitoring of relevant processes; identify challenges to scale-up of existing technologies.

The presence of SSHA approaches in proposed activities: **LOW** (identification of challenges should be interpreted as a SSHA task but this is not indicated).

An example of SSHA led-activities within the call remit: to prevent development of poorly socially integrated and useful technologies, SSHA should be integrated in all the stages to e.g. understand existing practices and so effectively indicate where new technological development is needed and of what kind; lead the co-design design of desirable technologies with stakeholders; assess socio-cultural and other barriers to uptake of technologies.

HORIZON-MISS-2023-SOIL-01-04: Innovations to prevent and combat desertification.

Summary of desired outcomes: The socio-economic and climatic drivers, the extent and the impacts of different types of land degradation; demonstration of economic viability and environmental effectiveness of solutions for the prevention of desertification and for the restoration of degraded land: increased access to solutions for land managers.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: Synthesize evidence on desertification drivers; identify and promote solutions and resilient practices, including through facilitating learning and providing policy recommendations.

The presence of SSHA approaches in proposed activities: **LOW** (while identifying drivers and facilitating learning are clearly areas of SSHA expertise, the focus is mainly on economics).

An example of SSHA led-activities within the call remit: understanding drivers of desertification includes disciplines beyond economics, and considers cultural and structural aspects such as legislative and governance frameworks, business models actors operate within, historical patterns of land access and/or dispossession, and others.

HORIZON-MISS-2023-SOIL-01-06: Soils in spatial planning

Summary of desired outcomes: the value of soils is better integrated in urban and spatial planning, including incorporation of nature-based solutions.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: understand how soils are incorporated into spatial planning; identify good practices and work with public authorities to identify bottlenecks and improve practice.

The presence of SSHA approaches in proposed activities: **MEDIUM** (the review falls within SSHA remit as does stakeholder knowledge co-production, but identifying local authorities as the most desirable target group is premature, and more focus could be given to understanding the legislative, economic, and other pressures which direct planning)

Further expansion of SSHA led-activities within the call remit: going beyond local authorities to understand spatial planning as a complex governance sphere in which interests of many actors interact and where power relations are unequal, and identifying the most promising groups to target or actions to leverage; understand how key urban and rural infrastructural development processes involve or disregard of soil functions as part of their best practice, and how this can be improved.

HORIZON-MISS-2023-SOIL-01-07: Back to earth: bringing communities and citizens closer to soil

Summary of desired outcomes: Increased societal awareness on the importance of soil; opportunities for engaging in creative ways in soil protection; cultural and creative industries engaged.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: networks and projects around art, humanities, cultural and creative industries to carry-out a range of activities and campaigns to elevate the importance and value of soils and ensure meaningful citizens' engagement.

The presence of SSHA approaches in proposed activities: **HIGH**

HORIZON-MISS-2023-SOIL-01-08: Co-creating solutions for soil health in Living Labs

Summary of desired outcomes: establishing LLs, increased capacities for participatory, interdisciplinary and transdisciplinary R&I approaches, practice oriented knowledge and tools are more easily available to land managers, strengthened collaboration, including with policy.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: carry out participatory and transdisciplinary research and innovation in living labs.

The presence of SSHA approaches in proposed activities: **MEDIUM** (while LL research described includes drivers and pressures, the neither the LL set up nor monitoring indicate social innovation and socio-cultural change as integral to the LL process).

Strengthening SSHA led-activities within the call remit: stress social, economic, and cultural innovation as integral to the LLs research and monitoring.

HORIZON-MISS-2023-SOIL-01-09: Carbon farming in Living Labs

Summary of desired outcomes: increased carbon sequestration in soils, increased capacities for participatory, interdisciplinary and transdisciplinary R&I approaches, practice-oriented knowledge and tools are more easily available to land managers, strengthened collaboration, including with policy.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: carry out participatory and transdisciplinary research and innovation in living labs.

The presence of SSHA approaches in proposed activities: **MEDIUM** (while LL research described includes drivers and pressures, the neither the LL set up nor monitoring indicate social innovation and socio-cultural change as integral to the LL process).

Strengthening SSHA led-activities within the call remit: stress social, economic, and cultural innovation as integral to the carbon LLs research and monitoring.

Mission Soil calls in the Horizon Europe Work Programme 2022 (only Research and Innovation Actions)

HORIZON-MISS-2022-SOIL-01-02: Improving food systems sustainability and soil health with food processing residues

Summary of desired outcomes: progress towards a circular bioeconomy within food production through incorporation of food-processing residues to improve soil health and water quality. To be achieved by strengthening interdisciplinary design of solutions.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: development of new processes and strategies; understand social, economic, and environmental barriers; co-design solutions and raise awareness.

The presence of SSHA approaches in proposed activities: **MEDIUM/LOW** (while social and economic aspects are mentioned, their incorporation is pre-framed as identifying barriers and opportunities. There is no explicit recognition of the role for SSHA in the delivery)

Strengthening SSHA led-activities within the call remit: explicitly call for a social science leadership on this issue, recognising that the lack of incorporation of food processing residues is a societal issue shaped by legislative, economic, cultural, and other societal drivers at different scales.

HORIZON-MISS-2022-SOIL-01-03: Soil biodiversity and its contribution to ecosystem services

Summary of desired outcomes: improve soil biodiversity through better scientific understanding; achieve change through knowledge exchange leading to changes in land management policy, planning, and practice.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: improved scientific understanding of links between biodiversity and ecosystem services; improved availability of soil biodiversity indicators; changes to policy and land management.

The presence of SSHA approaches in proposed activities: **ABSENT** (the call adopts the linear scientific knowledge exchange/diffusion model. The drivers and pressures on soil biodiversity are conceptualised only from within natural sciences and without consultation with stakeholders. Solutions are therefore to be designed without establishing any understanding of the social, economic, and cultural factors within different land management groups impacting soil biodiversity improvement or degradation)

Strengthening SSHA led-activities within the call remit: establish an understanding of the relationship between practices, values, economic drivers, and cultural narratives and soil biodiversity degradation or improvement within different areas of land management. Factors examined should include policies, legislation, infrastructures, and land management cultures, as well as land management practices as part of particular ways of living on the land (e.g. urban development, farming, forestry, conservation). Indicators and novel practices should be co-designed with end users, with clear involvement of the end users in the choice of indicators, co-design of tools and practices.

HORIZON-MISS-2022-SOIL-01-04: Remediation strategies, methods and financial models for decontamination and reuse of land in urban and rural areas

Summary of desired outcomes: reduce soil pollution and enhance restoration through enhanced understanding amongst stakeholders of soil pollution sources and state of soil contamination, and a better understanding of remediation strategies especially in their financial aspects.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: improved mapping of soil pollution in Europe; identify and characterise soil pollution pathways, receptors, and risks; develop strategies for action; identify and improve monitoring and remediation of polluted soils in light of TRL and cost-effectiveness; develop new financial and spatial planning models; explore potential for reuse of mining sites; enhance reporting.

The presence of SSHA approaches in proposed activities: **LOW/ABSENT** (the activities and framing do not call for any SSHA understanding of soil pollution, and do not call for a co-production or co-design of solutions. A fully linear model from science to the public is adopted. Only financial and spatial planning mentioned)

Strengthening SSHA led-activities within the call remit: understanding that pollution is 'matter of place', enhance the understanding of how infrastructures, legislation, policies, economic and cultural drivers, and other societal factors result in soil pollution in different soil types and land management contexts. Enhance the understanding of societal, cultural, and economic impacts of living with soil pollution amongst different communities within Europe. Provide insight into already existing strategies for living-with soil pollution, and low-cost and socially desirable strategies for soil remediation. Co-design with stakeholders pathways for addressing soil pollution through change to identified drivers. Understand why certain actors are enabled to pollute, and provide solutions for addressing pollution. With an incorporation of interdisciplinary perspectives, co-design strategies for restoration of polluted sites which are locally actionable for stakeholders and which support ecologically and socially just outcomes.

HORIZON-MISS-2022-SOIL-01-05: Monitoring, reporting and verification of soil carbon and greenhouse gases balance

Summary of desired outcomes: support the establishment of carbon farming through better understanding of carbon flux dynamics of carbon farming practices and their driving factors (from a natural scientific perspective); development of standards for carbon farming payment tracking; reducing financial and administrative burden of carbon farming; increased stakeholder faith in carbon markets.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: improved on-field measurement of soil carbon; improve temporal and spatial resolution on biological chemical and physical drivers of fluxes, accumulation, and storage of soil carbon; assess the effect of and soil's capacity for implementation of soil carbon farming practices on

landscape level; develop, standardise and demonstrates monitoring, reporting, and verifying methodologies; access economic and social impacts of carbon farming on the local rural economy; identify financially viable soil carbon farming practices; provide decision support tools.

The presence of SSHA approaches in proposed activities: **MEDIUM** (only the economic dimension of carbon farming is considered)

Strengthening SSHA led-activities within the call remit: understanding that adopting land management practices which lead to soil carbon sequestration includes economic, social, and cultural dimensions, studies should improve the understanding of how and whether carbon farming practices can become part of economically, socially, and culturally sustainable and vibrant land-based communities. This may include the investigation of stakeholder's understanding and valuation of soil carbon and of carbon markets, and co-design of strategies for soil carbon improvement and of carbon market structures which help stakeholders' achieve their objectives. Studies should consider the impact of carbon farming on existing livelihoods taking into consideration their economic, social, and cultural dimensions, and co-design carbon farming practices, and monitoring procedures, to enhance ecological and social justice outcomes, and minimise risk while maximising reward for land workers. Studies should consider the impact of pathways for just and sustainable incorporation of carbon farming into food systems (at all levels), land legislation, planning, and other areas of social life. Studies should propose how data justice and epistemic justice can be incorporated in soil carbon monitoring, reporting, and verification.

HORIZON-MISS-2022-SOIL-01-07: Foster soil education across society

Summary of desired outcomes: improved presence of teaching and communication on soil; higher uptake and diffusion of good practices and hands-on practices in soil education; embedding of soil literacy in curricula; increased awareness of the importance of soils and its functions.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: overview of soil related knowledge and educational needs; development of soil education courses and activities; dissemination; enhancing knowledge exchange

The presence of SSHA approaches in proposed activities: **HIGH**

HORIZON-MISS-2022-SOIL-01-09: Citizen science for soil health

Summary of desired outcomes: public awareness of the value of soils is significantly increased; citizens are empowered to take an active role in science through monitoring and gathering data; local data on soils is more available EUSO is enlarged with citizen science data.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: strategy for standardisation of soil health data submitted by citizen scientists; develop citizen science tools; ensure quality control of data; run initiatives; create a prototype data repository; develop case studies showing how data can be used by stakeholders; build capacity.

The presence of SSHA approaches in proposed activities: **MEDIUM** ('Consortia should ensure participation from partners with ample social sciences expertise'. The main limiting factor for SSHA is the specific understanding of citizen science as the provision of data by citizens to scientists. This leads to two issues: 1) while the objectives aim for behaviour change, it is assumed that this will follow from exposure to citizen science. In fact such a relation has not been sufficiently evidenced in literature. 2) activities require showing the usefulness of data to stakeholders, but the tool development is oriented not towards gathering data that is relevant to stakeholder decision-making, but to scientific research. As scientific research and stakeholder decision-making require different kinds of data, it is highly likely that this outcome will not be achieved.)

Strengthening SSHA led-activities within the call remit: studies should understand what forms of citizen science can influence behaviour change and aid local stakeholders in incorporating soil knowledge and information in their decision-making, planning, and their economic and socio-cultural change. Studies should identify successful citizen science initiatives and understand the relationship between their methodologies, approaches, and designs and the societal effects on enhancing soil literacy and behaviour change in soil practices. Studies should experiment with different forms of citizen science to test their outcomes. Studies should investigate how societally-impactful forms of citizen science can link with and reinforce scientific research. Studies should investigate and propose forms of citizen science which result in universal and equal access to soil data and information. Studies should investigate decolonial approaches to citizen science, and/or those which strengthen the capability of local stakeholders to act for soil health through place-based research on soils.

Mission Soil calls in the Horizon Europe Work Programme 2021 (only Research and Innovation Actions)

HORIZON-MISS-2021-SOIL-02-02: Validating and further developing indicators for soil health and functions

Summary of desired outcomes: progress towards a harmonised and cost-effective framework for measuring soil health and for developing a soil health index; improved monitoring capacity; support to policy.

The need for SSHA expertise in achieving desired outcomes: **LOW**

Summary of proposed activities: identify soil health indicators and proxies; this should include developing easy to use indicators.

The presence of SSHA approaches in proposed activities: **ABSENT**

Strengthening SSHA led-activities within the call remit: co-design of soil health indicators with stakeholder groups, understanding that appropriateness and ‘ease of use’ of soil health indicators are societal questions.

HORIZON-MISS-2021-SOIL-02-03: Linking soil health to nutritional and safe food

Summary of desired outcomes: Improved understanding of the soil health and food nexus, including R&I for transformation of food systems and spread of best practice.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: Support R&I to facilitate the transition towards healthy and sustainable dietary behaviour, including via LLs; improved understanding of how soil health influences food quality.

The presence of SSHA approaches in proposed activities: **MEDIUM** (while the last sentence clearly states that “proposals should bring together multiple types of scientific expertise in health and natural sciences, and social sciences and humanities. This topic should involve the effective contribution of SSH”, the research activities do not speak clearly to SSHA framings or methods: interdisciplinarity mentioned but only medical sciences named; qualitative and quantitative methods mentioned but only in reference to lab and in situ experimentation)

Strengthening SSHA led-activities within the call remit: with food systems inherently shaped by social, cultural, and economic factors, develop an understanding of socio-economic and cultural dimensions of the success of best practices, and propose and experiment with different forms of social innovation in their scaling up; explore the impact of cultural preferences in dietary choices.

HORIZON-MISS-2021-SOIL-02-04: Social, economic and cultural factors driving land management and land degradation

Summary of desired outcomes: increased evidence on the main factors driving land management and land degradation as a basis for actions by policy makers, land managers and other stakeholders.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: study a range of social, cultural, and economic factors in relation to soil health and land degradation and propose solutions.

The presence of SSHA approaches in proposed activities: **HIGH**

HORIZON-MISS-2021-SOIL-02-05: Incentives and business models for soil health

Summary of desired outcomes: increased investment opportunities in soil health, emergence of new value chains and products based on sustainable soil practices allowing consumers to make more informed decisions.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: produce an understanding of soil health investments, identify best practices, enhance actionable knowledge on soil health investment.

The presence of SSHA approaches in proposed activities: **HIGH**

HORIZON-MISS-2021-SOIL-02-08: Next generation soil advisors

Summary of desired outcomes: strengthening advisory services on soil health in a range of aspects.

The need for SSHA expertise in achieving desired outcomes: **HIGH**

Summary of proposed activities: identify main advice channels, analyse and enhance knowledge communication and upskilling using different pathways.

The presence of SSHA approaches in proposed activities: **HIGH**

Notes and references

ⁱ This means that if the projects aim at a change in the social relations with soils through e.g. change in individual behavior, in institutional approaches, in policy or governance, in markets, in stakeholder decision-making, in planning, and/or in land management practices, SSHA disciplines must be included.

ⁱⁱ This expert group could be convened and managed through a similar process as the think tanks under the project Soils for Europe SOLO, with the aim to identify and propose strategies for addressing key knowledge gaps in soil research from a SSHA perspective.

ⁱⁱⁱ *EU Mission Soil Deal for Europe: Implementation plan* (2021), p.5. Available https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/implementation-plans-eu-missions_en, accessed 9/5/2024.

^{iv} *Mission Soil Manifesto* (2023) available at <https://mission-soil-platform.ec.europa.eu/resource-library/mission-soil-manifesto>, accessed 11/05/2024.

^v While in EU documentation the acronym SSH is typically used, the list of disciplines monitored for SSH integration [add reference] shows that arts are also considered. In this document, we chose to elevate the importance of the arts and use the SSHA acronym.

^{vi} European Commission, Directorate-General for Research and Innovation, *Integration of social sciences and humanities in Horizon 2020 – Participants, budgets and disciplines 2014 - 2020 – Final monitoring report*, Publications Office of the European Union, 2023, <https://data.europa.eu/doi/10.2777/075642>, accessed 9/5/2024.

^{vii} Humanities, social science and artistic disciplines have recently turned attention to soils as part of a larger movement to understand environmental challenges through perspectives beyond natural science. While soil degradation and desertification are long-standing concerns in SSHA-inclusive sustainability research, new approaches include reimagining the social relevance of soil processes in order to articulate alternative paradigms for dealing with the increasingly entangled crises facing soils today (e.g. Neimanis A and Hamilton JM (2018) *Weathering. Feminist Review* 118(1): 80-84; Haraway DJ (2016) *Staying with the trouble: Making kin in the Chthulucene*. Duke University Press; Puig de la Bellacasa M (2019) Re-animating soils: Transforming human–soil affections through science, culture and community. *The Sociological Review* 67(2): 391-407; Krzywoszynska A (2019) Caring for soil life in the Anthropocene: The role of attentiveness in more-than-human ethics. *Transactions of the Institute of British Geographers* 44(4): 661-675, and many others). Simultaneously, art and design disciplines have played a special role in investigating the possibilities for soil protection by addressing themes of ethical, political and aesthetic nature that are often beyond the scope of soil scientific investigation (e.g. Toland A, Noller JS and Wessolek G (2018) *Field to palette: dialogues on soil and art in the anthropocene*. Boca Raton: CRC Press / Taylor and Francis; Feller C, Landa E, Toland A, et al. (2015) Case Studies of Soil in Art. *Soil – An Interactive Open Access Journal of the European Geosciences Union* 1(2): 543–559.) Reading groups, fellowships, artist residencies, and interdisciplinary research groups have recently come to life with a focus on soils, including: the Soil Culture residencies in the UK, the Zone2Source residencies in Amsterdam, Soil Futures at Arts Catalyst Sheffield, UK, the Composting Feminisms initiative in Sydney, Australia, the Anthropogenic Soils cluster at the Oslo School of Environmental Humanities in Norway, and the international Soil Care Network. Meanwhile, post-colonial debates on scientific expertise and the co-production of knowledge have started to make an impact on the wider soil science community, for example, in the recognition of feminist paradigms in diversification efforts (e.g. Dawson LB, Eric C.; Reyes-Sánchez, Laura B. (2021) International gender equity in soil science. *European Journal of Soil Science* 72(5): 1929-1939.; Berhe AA and Ghezzehei TA (2020) Race and racism in soil science. *European Journal of Soil Science* 72(3): 1292-1297), in citizen science campaigns (Sandén T, Wawra A, Berthold H, et al. (2021) TeaTime4Schools: Using Data Mining Techniques to Model Litter Decomposition in Austrian Urban School Soils. *Frontiers in Ecology and Evolution* 9), and in the establishment of new working groups in soil scientific societies.

viii “The increasing complexity of emerging phenomena cannot be fully understood or addressed from within knowledge silos, and requires confrontation and collaboration between diverse methods and approaches to the study of the same issue. Knowledge from social sciences and humanities (SSH), including arts, is particularly important to explore different meanings and dimensions that global challenges bring with them and to foster reflexivity over the methods through which they are enquired. SSH is fundamental for paving the way to interdisciplinary collaborations, with knowledge of science, technology, engineering, and mathematics (STEM), while maintaining a human-centric focus. (...) Effectively integrating SSH into all clusters, including all missions and partnerships, is a key principle of the programme. (...) SSH will be integrated into such projects, from their drafting to their selection and evaluation by evaluators with demonstrable SSH expertise.” *Horizon Europe Strategic Plan 2025-2027*, available https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/strategic-plan_en, accessed 15/06/2024.

ix European Alliance for Social Sciences and Humanities EASSH, “SSH Integration in Horizon Europe and its Missions”, January 2022, https://eassh.eu/Position-Papers/EASSH_SSH_Integration_HEu_Jan2022.pdf, accessed 15/03/2024.

x SSH integration - European Commission (europa.eu), accessed 9/5/2024.

xi After Burch, K., Guthman, J., Gugganig, M. et al. Social science – STEM collaborations in agriculture, food and beyond: an STSFAN manifesto. *Agric Hum Values* 40, 939–949 (2023). <https://doi.org/10.1007/s10460-023-10438-2>

xii Overland, I., & Sovacool, B. K. (2020). The misallocation of climate research funding. *Energy Research and Social Science*, 62, 101349. <https://doi.org/10.1016/j.erss.2019.101349>

xiii This is the so called ‘knowledge deficit model’ or action-gap model. For a good discussion see Simis MJ, Madden H, Cacciatore MA, Yeo SK (2016) The lure of rationality: Why does the deficit model persist in science communication? *Public Understanding of Science*. 2016 May;25(4):400-14.

xiv In transdisciplinary work it is important to recognize the difference between (and complementary relevance of) codified (scientific) knowledge and (tacit) experiential knowledge of stakeholders/real-world actors.

xv *EU Mission Soil Deal for Europe: Implementation plan* (2021), p.5. Available https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/implementation-plans-eu-missions_en, accessed 9/5/2024.

xvi Mission Soil Board’s view on Soil Health Living Labs under Horizon Europe (2023), p. 9. Available <https://mission-soil-platform.ec.europa.eu/resource-library/mission-soil-boards-view-soil-health-living-labs-under-horizon-europe>, accessed 9/5/2024.

ENOLL: European Network on Living Labs. <https://enoll.org/about-us/>, accessed 15/03/2024.

xvii Barry, A., & Born, G. (2013). *Interdisciplinarity: reconfigurations of the social and natural sciences*. In *Interdisciplinarity* (pp. 1-56). London: Routledge.

xviii Groups include INTEREACH, I2S, Team Science etc.

xix EASSH, EASSH Response to European Commission Consultation on Horizon Europe, February 2023. https://eassh.eu/Position-Papers/EASSH_HEUConsultation_March2023.pdf, accessed 15/03/2024.

xx Ibid.