



IMPROVING SOIL LITERACY IN EUROPEAN EDUCATIONAL SYSTEMS

THE CHALLENGE OF SOIL LITERACY IN EUROPE

CONTEXT

Soil represents a fundamental yet often overlooked resource in the fight against climate change and the promotion of environmental sustainability. Despite its crucial role, there is a widespread lack of awareness and understanding of soil's importance among the general population, students, and even some policymakers. This lack of "soil literacy" constitutes a significant obstacle to implementing effective sustainable land management policies.

The LOESS project (2023–2026), funded under the European Union's Mission "A Soil Deal for Europe," was created to address this challenge. With a collaborative approach involving 20 partners across 16 European countries, LOESS aims to improve the collective understanding of healthy soil's importance through innovative educational programs and continuous training activities.

THE PROBLEM

Soil plays a crucial role in mitigating and adapting to climate change. However, beyond scientific data, it is imperative for indi-

viduals to comprehend the impact of healthy soils on human life. The current educational systems in Europe exhibit substantial deficiencies in soil-related education, leading to inadequate awareness of its significance for environmental sustainability, food security, and human health. This deficiency in soil literacy influences decisions and behaviors that deteriorate soil quality, results in insufficient public support for soil protection policies, limits the integration of soil-related topics in educational curricula, and creates a shortage of specialized skills in the agricultural and environmental sectors.

THE LOESS APPROACH

The LOESS project seeks to address these issues by mapping existing soil-related educational materials and programs, identifying training needs across various contexts and educational levels, and establishing Communities of Practice (CoPs) in 15 European countries. These CoPs unite soil experts, pedagogy specialists, policymakers, and civil society representatives. Participation in CoPs is essential for the collaborative development of new courses, teaching modules, and learning tools, while also implementing hands-on community engagement activities, including augmented reality applications and participatory mapping.

LOESS: MAIN ACTIVITIES

- ✦ **MAPPING OF EXISTING SOIL-RELATED MATERIALS AND EDUCATIONAL PROGRAMMES AND IDENTIFICATION OF EDUCATIONAL NEEDS.**
- ✦ **DEVELOPMENT OF A TOOLKIT OF SOIL EDUCATION AND TRAINING MATERIALS AND RESOURCES** based on existing good examples as well as new ones developed by LOESS.
- ✦ **ENGAGEMENT AND CONNECTION OF STAKEHOLDERS IN COMMUNITIES OF PRACTICE** in 15 European countries.
- ✦ The **CO-CREATION AND PILOTING OF NEW COURSES, TEACHING MODULES, EDUCATIONAL MATERIALS AND LEARNING TOOLS** for soil education for use in primary and secondary schools as well as universities and vocational colleges.
- ✦ **HANDS-ON ENGAGEMENT ACTIVITIES RELATED TO SOIL EDUCATION THROUGH COMMUNITY PROJECTS** involving students and local communities; the development of an augmented reality app; and crowd mapping to identify, visualize and address local soil problems.
- ✦ **CAMPAIGNS AND DISSEMINATION ACTIVITIES** aimed at schools, universities, decision makers and members of the public.
- ✦ **ENGAGEMENT WITH POLICY MAKERS** and lobbying for the advantages of integrating soil-related activities into formal education.

RESEARCH METHODOLOGY AND KEY FINDINGS

RESEARCH APPROACH

The LOESS project looked into the current state and future of soil education in Europe. This involved two connected studies.

The first study examined the current situation and goals for teaching about soil health at five levels: primary, secondary, vocational, higher education, and the general public. It used a mix of methods, including desk research, focus groups, and interviews in 15 European countries. The study looked at things like the purpose of education, partnerships,

learning settings, teaching methods, activities, and basic ideas. It also gathered feedback from Communities of Practice (CoPs) in each country involved.

The second study used an online survey for European teachers to assess their knowledge and teaching methods about soil health. This study found challenges, needs, and attitudes towards teaching soil topics. It also explored where teachers get their information and which curriculum topics they find most important or difficult.

KEY FINDINGS

The research identified significant discrepancies between the current methods of teaching soil and the ideal approach.

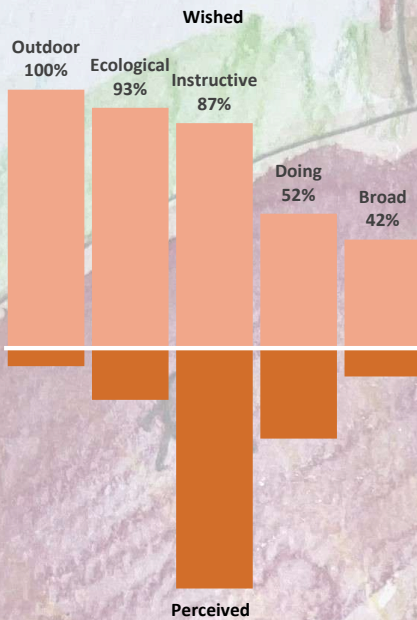
Increase "soil health" in educational offerings. Integrating "soil health" into educational curricula across Europe is not merely advantageous but imperative. At present, educational programs that address soil often restrict their focus to basic facts, neglecting both soil health assessment and a systems-based understanding of soil functions and their societal relevance. This educational gap must be bridged to equip future generations with the knowledge necessary to maintain healthy soil, which is crucial for sustainable agriculture and environmental conservation. By incorporating soil health into the curriculum, we can cultivate a deeper understanding of its significance and ensure a more sustainable future.

Change is needed in educational focus. Current approaches in schools and universities mostly centre on delivering facts and tech-

UNEARTHING THE GAP TO REIMAGINE SOIL HEALTH EDUCATION

DISCREPANCIES IN SOIL HEALTH EDUCATION

Our study reveals a **broad divergence between current perceptions and the envisioned future of soil health education across all dimensions examined.**



LEARNING ENVIRONMENTS

Current education mostly takes place indoors, while there's a strong wish to move toward **more outdoor and field-based learning.**

EDUCATIONAL APPROACH

Participants would like to see a shift in mindset: Away from fragmented, mechanical teaching, towards **more ecological and holistic ways of thinking and learning.**

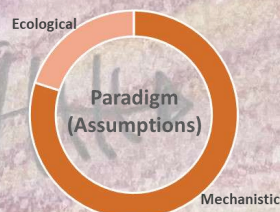
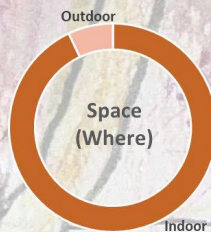
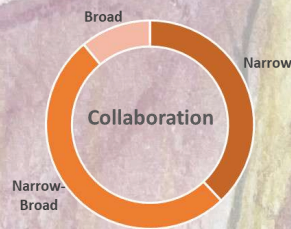
LEARNING METHODS

There is a strong call for **greater emphasis on experiential learning and extensive collaboration across disciplines.** These methods are still rare but seen as key for meaningful soil education.

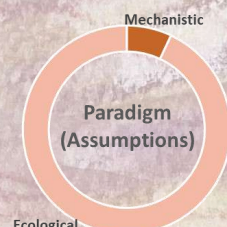
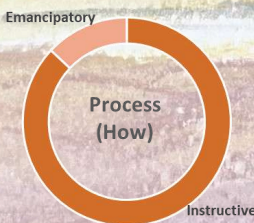
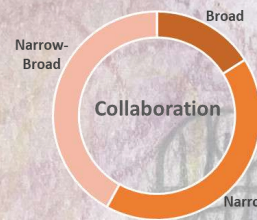
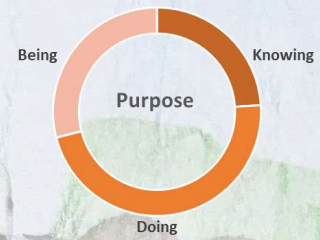
TEACHING STYLE

While a shift toward **more student-centred learning** is desired, a balance remains between aspiration and the current instruction-oriented style.

PERCEIVED



WISHED



nical skills. However, education should also foster responsible behaviour and support the development of values. Today, learning largely happens indoors, in lecture halls — too often disconnected from real-world soil and environmental contexts.

Learning approaches and environments. It is essential to challenge this norm by integrating more outdoor, experiential learning opportunities in settings such as gardens and forests. These environments not only enrich the educational experience but also foster a profound appreciation for nature, thereby promoting holistic cognitive and emotional growth. By adopting this innovative approach, we can inspire a generation of well-informed learners who are deeply attuned to environmental stewardship and active participation.

Educational paradigm shift. We must rethink our educational approach by viewing soil not as isolated fragments but as a crucial part of a complex, interdependent system that encompasses both humans and nature. This shift is vital for fostering a deep understanding of soil's essential role in our ecosystem. By embracing this holistic perspective, we can better prepare future generations to address urgent environmental challenges, ultimately promoting a more sustainable and harmonious coexistence with our natural world.

Collaboration patterns. Imagine the transformative potential of collaboration when not only teachers and students but also farmers, businesses, and policymakers come together. By broadening our collaborative efforts to in-



clude these key groups, we can tap into a wide array of expertise and viewpoints, driving innovation and progress. This inclusive approach is not merely advantageous; it is crucial for developing sustainable solutions to the complex challenges we face today. Let us seize this opportunity to create a more interconnected and resilient future by working together across all sectors.

Thematic focus. The pressing concern now centers on the urgent issue of soil pollution, its harmful effects, and the necessary protective measures. It is crucial to thoroughly address all EU soil objectives, integrating them seamlessly with broader climate and health goals. This alignment is not merely advantageous but essential for sustainable progress.

Educators' awareness. Educators are urged to deepen their understanding of the EU's "A Soil



Deal for Europe." Their current lack of knowledge and inadequate training resources impede their ability to effectively teach the critical subject of soil health. Addressing this educational gap is vital to equipping teachers with the tools they need to inspire students to value and protect our soil, a fundamental resource for our planet's sustainability.



IDENTIFIED NEEDS

Our findings compellingly underscore the necessity to address specific needs at both micro and macro levels to induce significant change soil health education. By doing so, we can ensure a sustainable future for our agricultural practices and environmental stewardship.

MICRO-LEVEL NEEDS (INDIVIDUAL EDUCATORS AND CLASSROOMS)

Enhanced educator training

- ♦ Specialized content knowledge on soil health topics
- ♦ Pedagogical skills for outdoor, experiential, and systems-oriented teaching approaches

Teaching materials and resources

- ♦ High-quality, accessible educational resources on soil health
- ♦ Equipment and tools for hands-on soil investigation and monitoring

Awareness building

- ♦ Strategies to increase educator awareness about the EU Mission Soil
- ♦ Better communication of soil health relevance to various educational contexts

MACRO-LEVEL NEEDS (SYSTEM-WIDE CHANGES)

Curriculum revision

- ♦ Integration of soil health topics within formal curricula
- ♦ Alignment with EU Mission Soil objectives and Sustainable Development Goals

Assessment reform

- ♦ Revision of educational goals and performance assessment criteria
- ♦ Development of evaluation methods that balance knowledge, skills, and values

Transdisciplinary collaboration

- ♦ Dedicated programs and funding for cross-sector partnerships
- ♦ Frameworks for connecting educational institutions with community stakeholders

Policy support

- ♦ Educational policy reforms to facilitate innovative teaching approaches
- ♦ Administrative support for outdoor and experiential learning initiatives



RECOMMENDATIONS FOR REGIONAL AND LOCAL DECISION MAKERS

To effectively address these pressing challenges, it is imperative to acknowledge that transformative change cannot be achieved overnight, nor can it depend solely on the determination of a select few. Instead, it demands a concerted and coordinated effort at every level, ensuring that collective actions culminate in meaningful and lasting change.

We strongly encourage regional and local decision-makers and stakeholders to contemplate and discuss the following recommendations, designed to address the needs identified above, to drive concerted deliberations. We believe that these strategies are crucial not only address current demands but also establish a foundation for sustainable progress and prosperity within our communities. Collective and coordinated actions are crucial in driving meaningful change for the benefit of all.

FOR REGIONAL COUNCILLORS/MINISTERS FOR AGRICULTURE, ENVIRONMENT, AND EDUCATION

- ✦ Integrate soil health across policy domains
 - ✦ Establish cross-departmental working groups on soil literacy
 - ✦ Develop regional soil health education strategies aligning environmental, agricultural, and educational objectives
- ✦ Create regional funding mechanisms
 - ✦ Allocate dedicated budget lines for soil

education initiatives

- ✦ Leverage European Structural Funds to support educational infrastructure for soil literacy



- ✦ Establish regional centres of excellence
 - ✦ Support the creation of specialized centres focusing on soil health education
 - ✦ Foster research-practice partnerships between universities and schools

FOR DIRECTORS OF REGIONAL DEPARTMENTS FOR TRAINING AND EDUCATION

- ✦ Reform professional development programs



- ♦ Integrate soil health modules into teacher training curricula
- ♦ Create continuing professional development opportunities focused on innovative soil education methodologies



- ✦ **Update regional curriculum guidelines**
 - ♦ Review and revise regional curriculum frameworks to include soil health topics
 - ♦ Develop assessment guidelines that value practical and experiential learning about soil
- ✦ **Support educational innovation**
 - ♦ Create flexible regulatory frameworks allowing for outdoor learning activities
 - ♦ Establish innovation grants for schools

implementing soil literacy programs

FOR LOCAL AUTHORITIES (MAYORS AND MUNICIPAL COUNCILLORS)

- ✦ **Develop local soil education initiatives**
 - ♦ Create municipal soil education programs linked to local environmental challenges
 - ♦ Establish community science initiatives focused on soil health monitoring
- ✦ **Repurpose public spaces for soil education**
 - ♦ Transform suitable public lands into educational soil gardens
 - ♦ Create demonstration sites showcasing sustainable soil management practices
- ✦ **Foster local educational networks**
 - ♦ Facilitate cooperation between schools, farmers, and environmental organizations
 - ♦ Support community-based learning activities around local soil issues

FOR SCHOOL PRINCIPALS AND EDUCATIONAL COORDINATORS

- ✦ **Redesign learning environments**
 - ♦ Create outdoor learning spaces focused on soil education
 - ♦ Establish school gardens with dedicated soil monitoring stations
- ✦ **Build local partnerships**
 - ♦ Develop formal collaborations with local environmental organizations
 - ♦ Create internship opportunities with farms, environmental agencies, and green businesses



✦ Adapt school schedules

- ✦ Restructure timetables to accommodate field-based soil education activities
- ✦ Create dedicated project weeks focusing on soil health

ing soil ecosystem services

✦ Train environmental educators

- ✦ Provide specialized training on soil health for environmental educators
- ✦ Create professional networks for sharing soil education best practices

FOR MANAGERS OF PROTECTED AREAS AND ENVIRONMENTAL CENTRES

✦ Develop specialized soil educational programs

- ✦ Create immersive soil education experiences for schools and the general public
- ✦ Develop interpretive materials highlight-

✦ Establish demonstration sites

- ✦ Create educational installations showcasing soil profiles and soil functions
- ✦ Develop comparative plots demonstrating different soil management practices

LOESS TEACHING AND LEARNING RESOURCES

LOESS has collaboratively developed several teaching and learning resources. Some of them are already available on the project's website, while others are still being finalised and will be available soon.

COMPLETED RESOURCES

- ✦ **CROWDMAPPING TOOL**: An interactive platform that enables users from schools, universities, and the wider public to identify local soil-related issues.
- ✦ **MOOC (MASSIVE OPEN ONLINE COURSE)**: Designed to offer professional development for teachers and to provide and introduction to innovative methods to integrate soil health into classroom teaching.
- ✦ **FOUR LEARNING SCENARIOS** aimed at STEM educators teaching in schools designed to support incorporating soil topics into their teaching. These learning scenarios follow the BSCS 5E Instructional Model and integrate innovative pedagogical approaches.
- ✦ **COMMUNITY ENGAGED RESEARCH AND LEARNING MODULE FOR LECTURERS**: a structured digital educational program that helps university educators enhance their teaching through focused content, collaborative activities, and guided practice.
- ✦ **GLOSSARY**: a list of key terms that with definitions related to soil available in eight different languages. It is regularly updated throughout the duration of the project to ensure accuracy and relevance.

COMING SOON

- ✦ **A BLUEPRINT** outlining sustainable practices for educational settings, including school gardens, school practicum, "Guardians of the Soil Microverse," and Tea Bag experiments. It includes a framework for Soil Education Measures. The blueprint will be integrated in the European Atlas of Soil Education and Training.
- ✦ **AN AUGMENTED REALITY (AR) APPLICATION**: an interactive digital tool that uses virtual 3D models, animations, and simulations onto the real world to help users explore and understand soil ecosystem services in a playful way. The app is currently being tested.
- ✦ **TRAINING MODULES FOR STUDENTS BY STUDENTS**: collaborative educational resources in which students contribute to the development of instructional content for their peers. These co-created modules aim to foster both subject expertise and essential soft skills through practical engagement with real-world issues.
- ✦ **EUROPEAN ATLAS OF SOIL EDUCATION AND TRAINING**: will gather best practices and tools developed and tested through project activities, including the Augmented Reality (AR) tool.



BUILDING TERRITORIAL PARTNERSHIPS FOR SOIL LITERACY

To maximize impact, regional and local stakeholders should develop integrated approaches through territorial partnerships:

- **Create local soil education consortia**
 - ♦ Bring together educational institutions, environmental organizations, agricultural stakeholders, and local authorities
 - ♦ Develop shared resources and coordinated educational campaigns
- **Establish "soil literacy territories"**
 - ♦ Designate geographic areas for intensive soil education activities
 - ♦ Create comprehensive programs linking formal and informal learning opportunities
- **Develop multi-stakeholder knowledge networks**
 - ♦ Connect scientific expertise with educational practice and local knowledge
 - ♦ Create platforms for ongoing knowledge exchange and co-creation
- **Link soil education to territorial development**
 - ♦ Integrate soil literacy objectives into regional development plans
 - ♦ Create synergies between educational programs and sustainable land management initiatives

CONCLUSIONS

Improving soil literacy across European educational systems requires coordinated action at multiple levels of governance. Regional and local policy and decision makers have a crucial role to play in creating enabling conditions for innovative soil education approaches that connect knowledge acquisition with experiential learning and value development. By implementing the recommendations outlined in this policy brief, decision makers can contribute significantly to the objectives of the EU Mission "A Soil Deal for Europe" while enhancing educational quality and environmental stewardship in their territories. The LOESS project offers valuable resources, case studies, and partnership opportunities to support these efforts.

This policy brief was developed as part of the LOESS project (2023–2026), funded by the European Union under the Mission "A Soil Deal for Europe." For more information: www.loess-project.eu It has been curated by the team of the University of Sassari. Revisions: by Wissenschaftenladen Bonn.



CHECK THE MAP
ON THE HOMEPAGE
AND GET TO KNOW
THE PARTNERS

Photo credits: images from LOESS Summer Camp in Italy.

Courtesy of Cooperativa Controvento.

