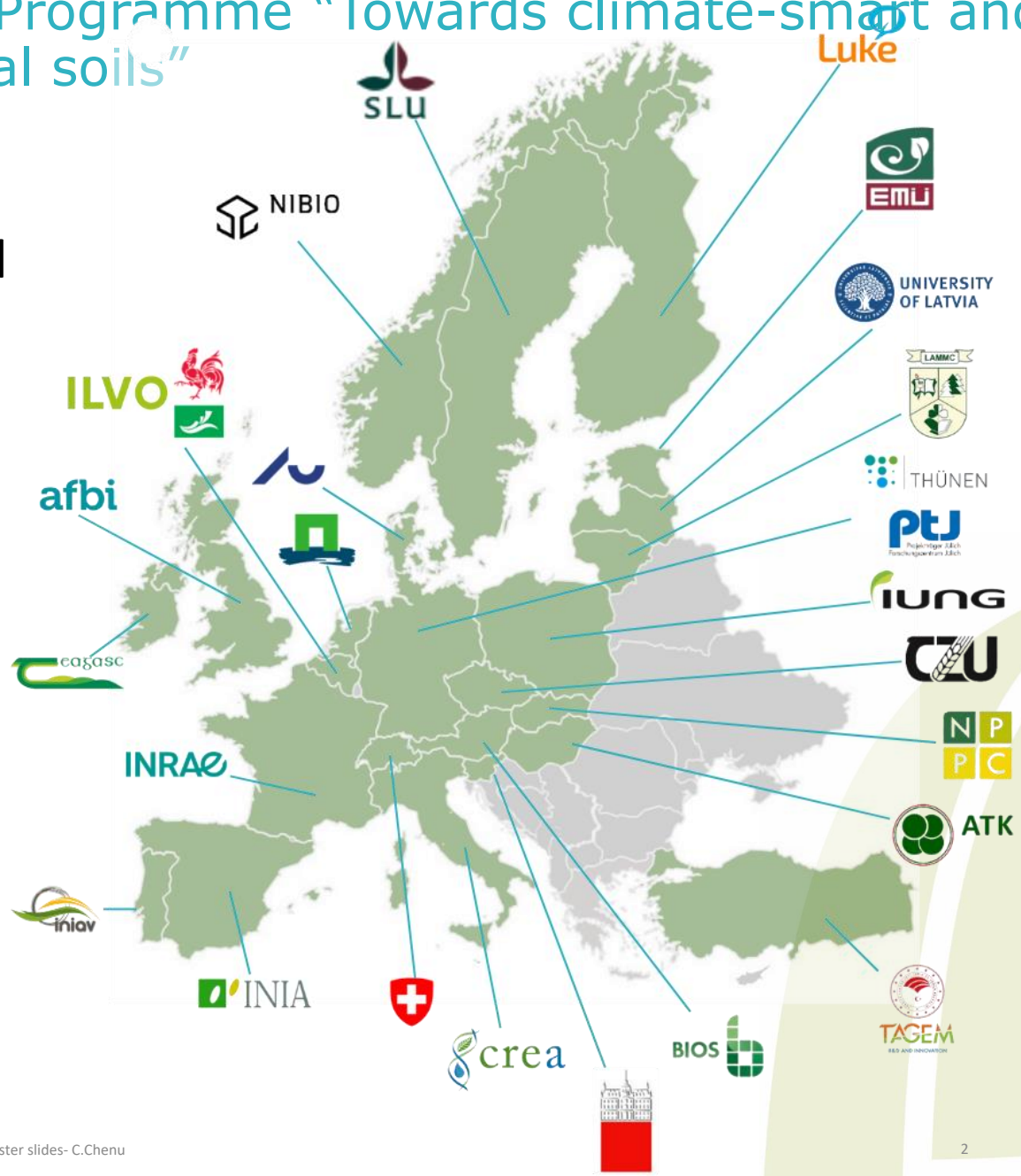
agreement No 862695

CREA E IL PROGETTO EJP SOIL
European Joint Programme SOIL
Towards climate-smart sustainable management of agricultural soils

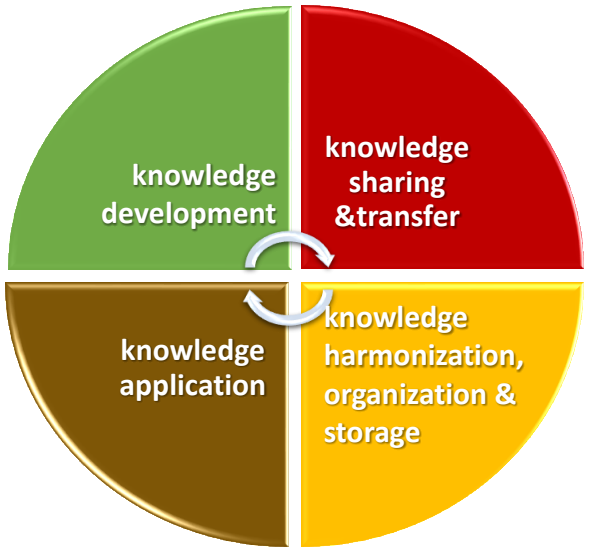
Maria Fantappiè
Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria
AGRICOLTURA E AMBIENTE

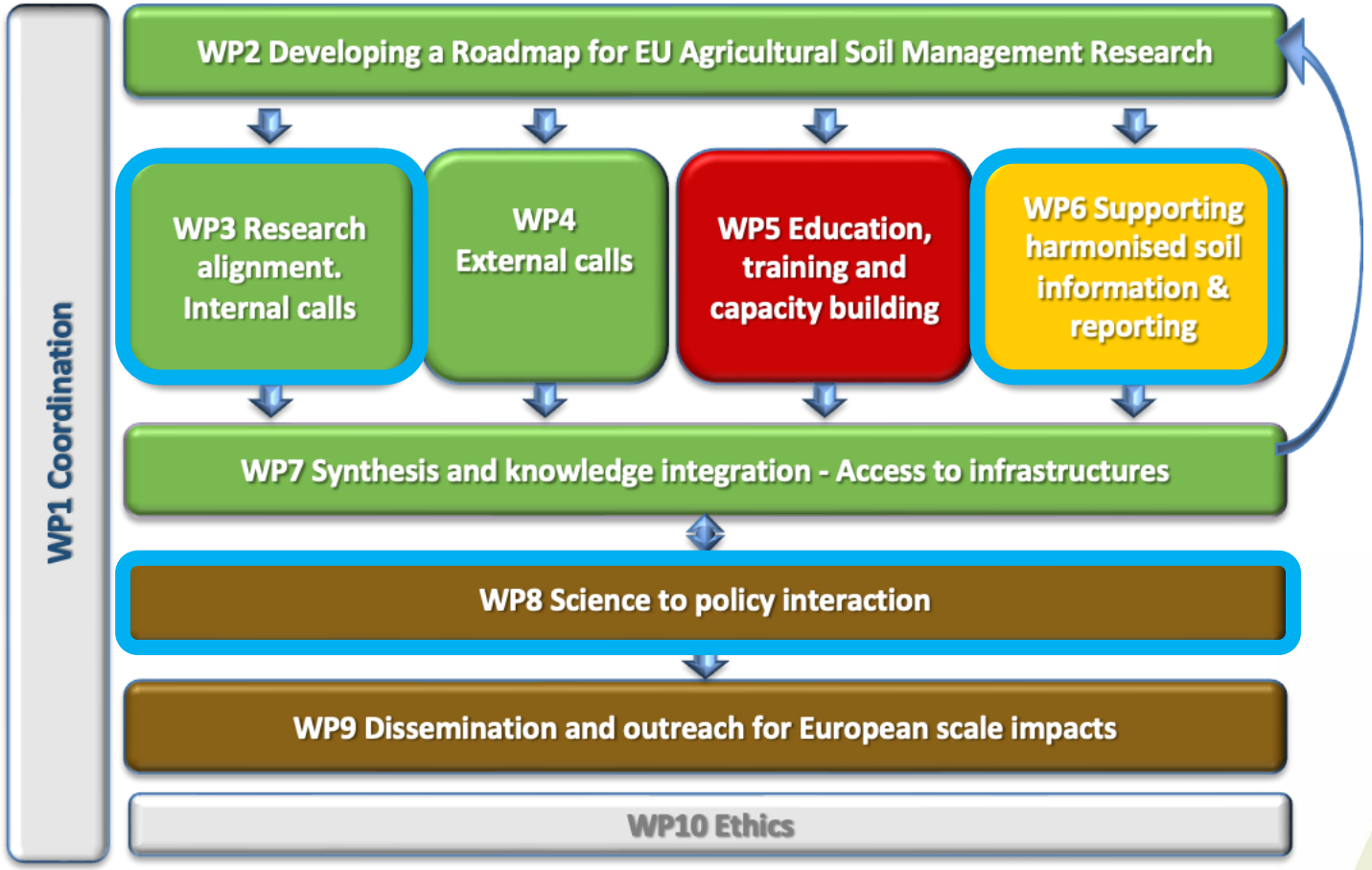
EJP SOIL: A European Joint research Programme "Towards climate-smart and sustainable management of agricultural soils"

- **Co-fund action:** ☞ coordinated research and innovation programme EU & countries
- **Critical Mass:** ☞ 24 countries, 26 partners, > 1000 scientists
- **Public- public funding**: 50% EC – 50% institutes
- **Annual Programming:** 2020-2025
- **Wide range of activities**



EJP SOIL: Work Packages structure



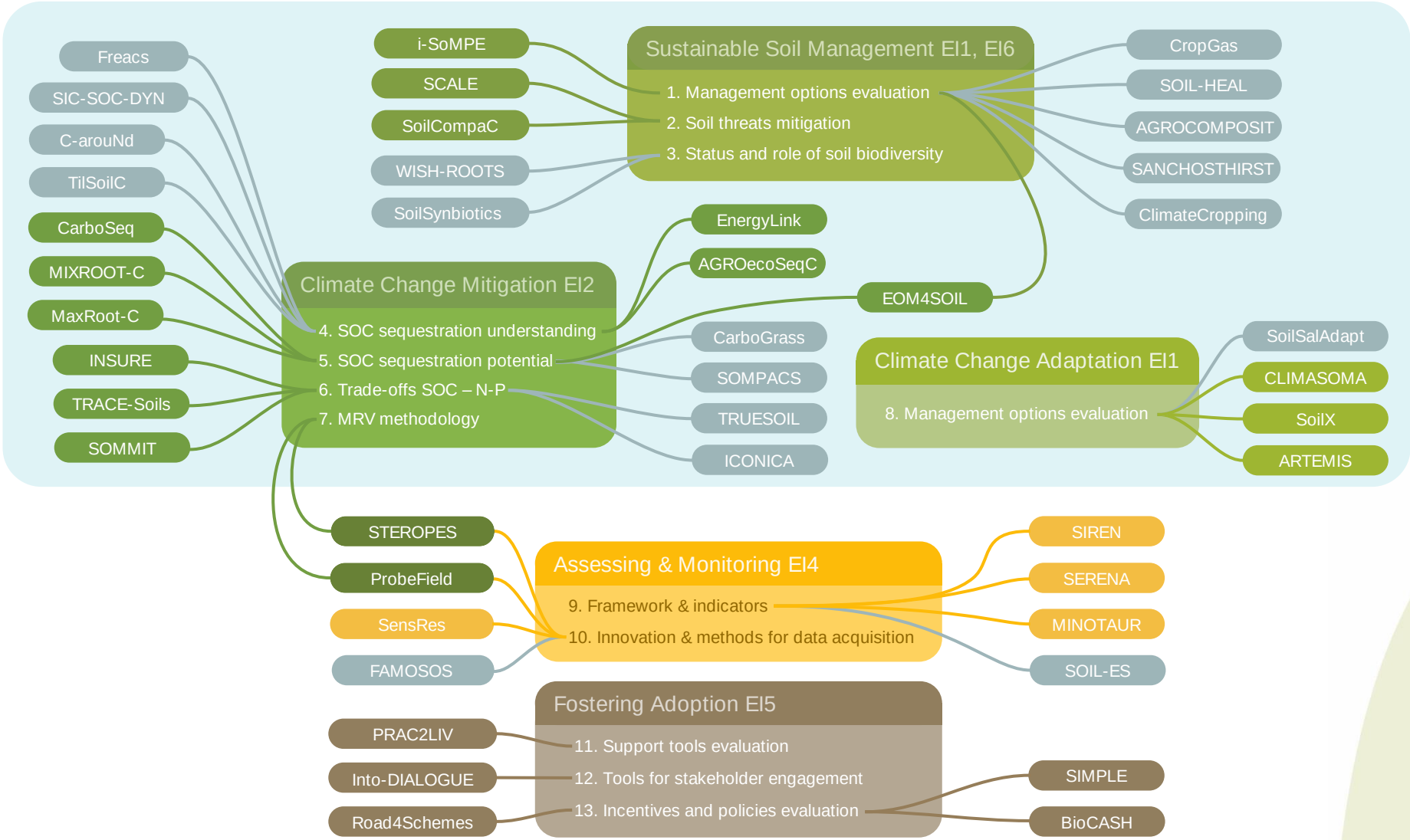


EJP = European Joint Programme.
È un programma di ricerche integrate, un progetto di progetti
Il CREA coordina il WP6 e co-coordina il WP8.

EJP SOIL
European Joint Programme

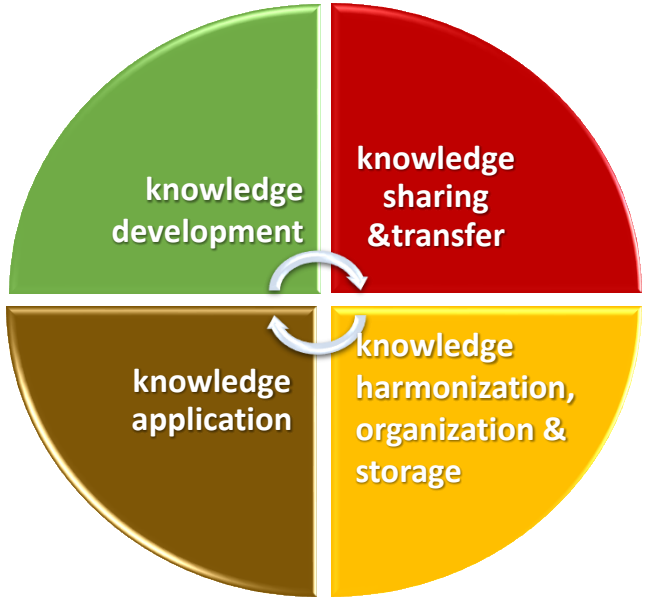
knowledge development

Internal and external research projects



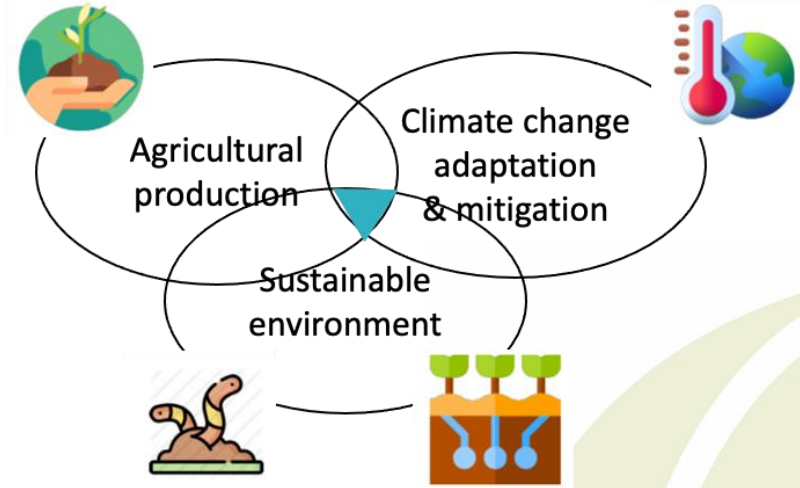
EJP SOIL
European Joint Programme

EJP SOIL, Towards climate-smart and sustainable management of agricultural soils: Knowledge framework & expected impacts



- understanding of soil management for climate change mitigation, adaptation, sust° production & sustainable environment
- understanding soil carbon sequestration and its contribution to climate change mitigation
- strengthening scientific capacities and cooperation
- supporting harmonised European soil information
- fostering the uptake of climate-smart sustainable soil management practices
- developping region-specific fertilisation practices

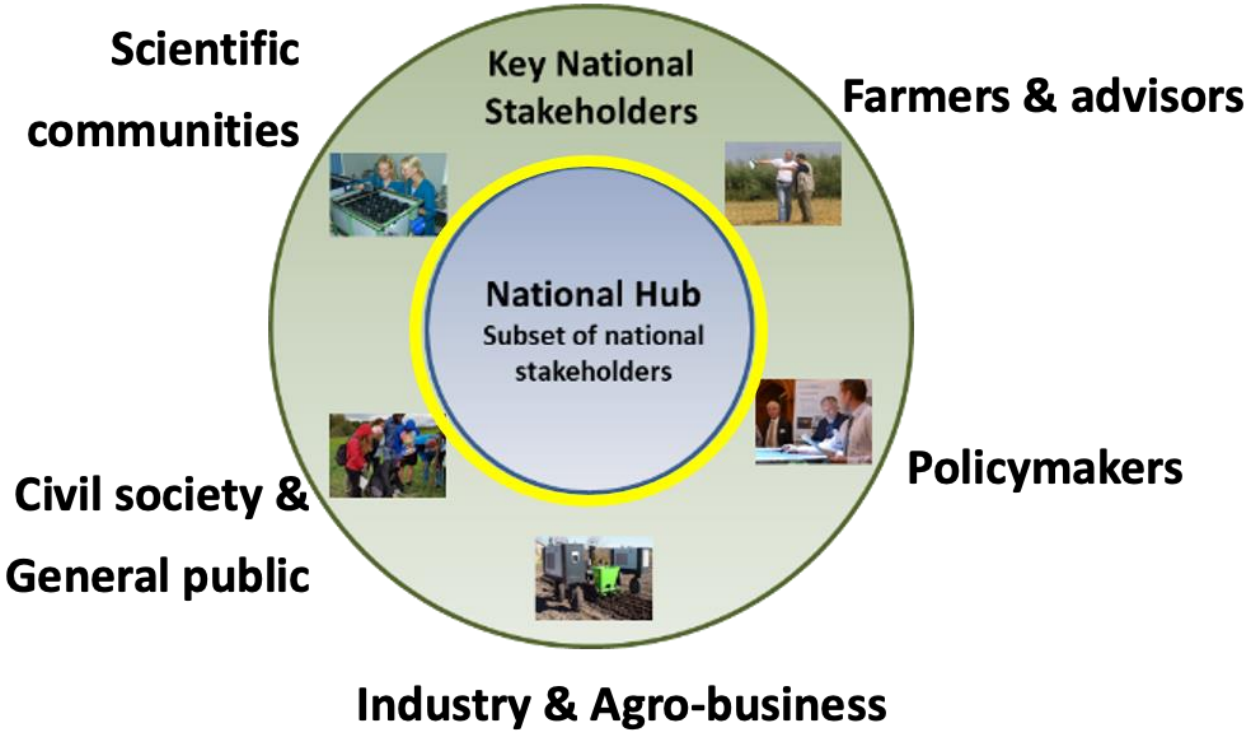
Long-term alignment of soil research



Farmers /farming sector are stewards of land and soil resources

EJP SOIL
European Joint Programme

EJP SOIL National Hubs: a new instrument for national stakeholders' consultation & science - policy interface



In each country, under responsibility of Programme Owners, not compulsory, flexibility

- Provide input & feedback to EJP SOIL programme
- Voice national position & needs
- Contribute to and learn from the work done in research
- Contribute to dissemination of EJP SOIL outputs.




ANALISI DEL CONTESTO ISTUTUZIONALE
SUOLO FRA AGRICOLTURA E AMBIENTE

European Commission
DG-ENV-AGRI … other DGs

FAO
IPCC UNCCD

IUSS

… OTHER INTERNATIONAL ENTITIES

Livello internazionale

JRC-ESDAC- EUSO

GSP – GLOSOLAN - INSII

Richieste internazionali di reporting sullo stato di salute dei suoli

Livello nazionale

CREA Coordina EJPSOIL per l'Italia

MASE

Terze parti del CREA nel progetto

CREA

ISPRA
ENEA

CNR
SISS

UN… altri centri ricerca

UNIVERSITÀ DEGLI STUDI DI PALERMO

SSR (Servizi del Suolo Regionali) – RETE ARPA regionali – Autorità di Bacino

ERSAF

Agris

Livello regionale

Agricoltori, Associazioni di categoria, Entità pubbliche che gestiscono i terreni di pubblica proprietà.

Livello locale

L'ITALIAN SOILHUB - LA RETE NAZIONALE PER LA PROTEZIONE DEL SUOLO

SOIL HUB

CREA CREA-AA CREA-PB UniPA CNR-IBE ENEA ISPRA ERSAF AGRIS

Dal 2020 è attivo il progetto SOILHUB, finanziato da MASAF e coordinato dal CREA (**Roberta Farina**), che ha come principale obiettivo proprio la messa a sistema (rete) della complessa realtà di competenze, conoscenze, esperienze in tema di protezione del suolo presenti in Italia.

In questi anni SOILHUB ha supportato l'implementazione e partecipazione dell'Italia al programma EJPSOIL e alla Global Soil Partnership della FAO.

Attualmente ne fanno parte per il livello nazionale CREA, CNR, ISPRA, ENEA, l'UNIPA come rappresentante del mondo accademico, e ERSAF, AGRIS, e IPLA per il livello regionale.

https://soilhub.crea.gov.it/homepage/rea.gov.it

WP2 - Knowledge development
DEFINIZIONE DELLE PRIORITA' DI RICERCA DELLA ROADMAP

Coordinamento per l'Italia di Silvia Vanino e Roberta Farina del CREA

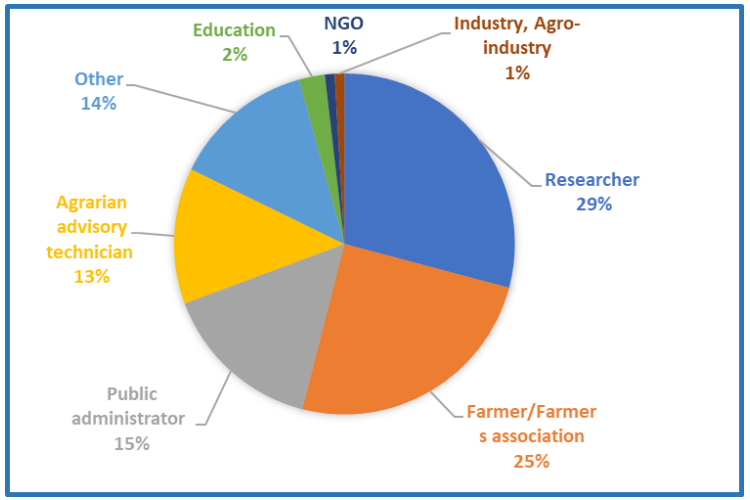
EJP SOIL
European Joint Programme

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652615.

Barriers And Opportunities Of Soil Knowledge To Address Soil Challenges: Stakeholders' Perspectives Across Europe

Table 2. Soil challenge defined as the top priority by stakeholder in the various European Geographic Zones. (SOM=soil organic matter, GHG=greenhouse gases, I=improving, A=avoiding).

	Northern Europe	Western Europe	Central Europe	Southern Europe
SOM & peat soil conservation (I)	42%	40%	31%	16%
Water storage capacity (I)	14%	8%	13%	39%
Soil sealing (A)	6%	3%	17%	18%
Nutrient retention or use efficiency (I)	17%	6%	5%	12%
Erosion (water/wind/tillage) (A)	6%	7%	12%	10%
Soil compaction (A)	7%	7%	12%	0%
Soil biodiversity (I)	3%	11%	5%	2%
GHG emissions (A)	1%	16%	1%	2%
Contamination (A)	6%	0%	0%	0%
Disease suppression (I)	0%	0%	3%	0%
Salinization and acidification (A)	0%	2%	0%	0%



The most important barriers identified by stakeholders are technical, political, social and economic obstacles, which strongly limit the development and full exploitation of the outcomes of soil research.

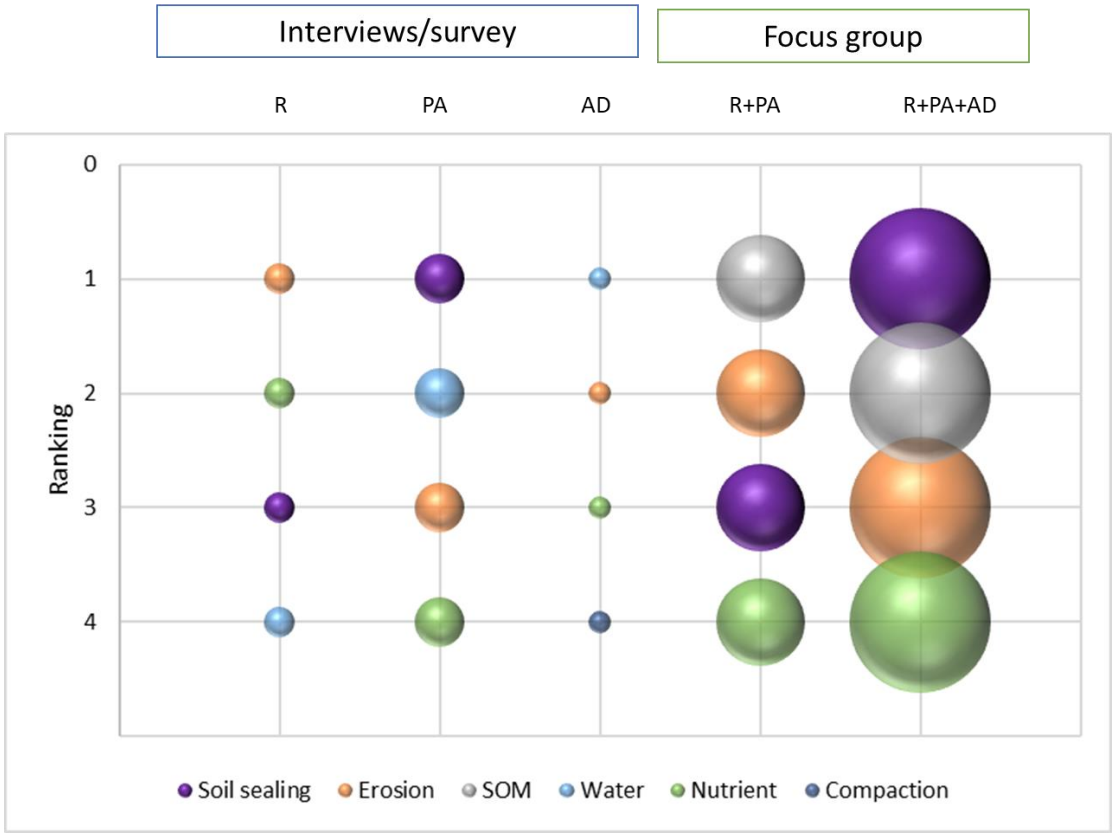
Four important needed actions were identified to overcome barriers:

1) increases in research funding,
2) the maintenance and valorization of long-term experiments,
3) the creation of knowledge sharing networks and interlinked national and European infrastructures,
4) the development of regionally-tailored soil management strategies.

EJP SOIL
European Joint Programme

Vanino et al. 2023. https://doi.org/10.1016/j.jenvman.2022.116581

Soil priorities for Italy. A multi-stakeholder consultation, barriers and opportunities for research system



Soil challenges prioritized by stakeholder in Italy. The size of each sphere represents the number of respondents compared to the total stakeholders identified. **R** stands education and research representatives, PA for public administrators, and AD for advisors/technical experts.

Concerning soil knowledge development, the barriers identified by all the stakeholder groups are mainly related to “Capacity building” and “Networks” categories.

This indicates that scientific and technical aspects play a major role in hindering knowledge development, together with the lack of coordination and interconnections among public authorities, research institutions, farmers and farmers' associations.

Opportunities to overcome these barriers can emerge by:

1) switching from top down to bottom-up research;
2) research funding and critical mass increase in soil science domain;
3) enhancing the coordination between public authorities and research institutions.

EJP SOIL
European Joint Programme

Vanino et al. 2022. https://doi.org/10.1016/j.geodrs.2022.e00528

WP6 Supporting EU-harmonised soil information systems and reporting e WP3 - Knowledge development

alcuni dei risultati dei progetti interni di ricerca su Assessing and monitoring soils

Maria Fantappiè, Fenny van Egmond, Antonio Bispo, Zsófi Bakacsi, Rudi Hessel, Johanna Wetterlind, Bozena Smreczak, Paul van Genuchten, Giovanni L'Abate, Andrea Lachi, Stefania Morrone, Nicolas Saby, Martin Knotters, Claire Froger, Elena Tondini, Dick Brus, Claire Chenu, Silvia Vanino, Roberta Farina, Stefano Mocali, Jack Faber.

EJP SOIL
European Joint Programme

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652615.

LE POLITICHE EUROPEE PER L'AGRICOLTURA E L'AMBIENTE RICHIEDONO IL MONITORAGGIO DEL SUOLO

9 OBIETTIVI DELLA PAC

GARANTIRE UN GIUSTO REDDITO | AUMENTARE LA COMPETITIVITÀ | RIEQUILIBRARE LA FILIERA | CONTRASTARE I CAMBIAMENTI CLIMATICI | TUTELARE L'AMBIENTE | CONSERVARE I PAESAGGI E LA BIODIVERSITÀ | SOSTENERE IL RICAMBIO GENERAZIONALE | RIVITALIZZARE LE AREE RURALI | PROTEGGERE LA SALUTE E LA QUALITÀ DEL CIBO

UE		Stato Membro
Stabilisce un set di strumenti e regole base		Può decidere quali misure possano essere più efficaci per il raggiungimento degli obiettivi sulla base delle proprie peculiarità
Aiuta gli agricoltori attraverso soluzioni su misura focalizzate sui risultati e non sui processi		Sviluppa un Piano Strategico, soggetto ad approvazione e monitoraggio della Commissione, definendo le misure scelte e i risultati attesi
Supporta direttamente gli agricoltori per garantire stabilità e prevedibilità		Indicatori di risultato predefiniti consentono di valutare i progressi fatti per il raggiungimento degli obiettivi strategici
Più incentivi per gli agricoltori che vanno oltre gli obiettivi minimi e maggiori penalizzazioni per il mancato raggiungimento		Nuovo sistema per monitorare e indirizzare l'implementazione delle politiche attraverso un sistema di incentivi e sanzioni

NELLA SOIL MONITORING DIRECTIVE E NEL REGOLAMENTO EUROPEO PER CERTIFICARE ASSORBIMENTI C02 DA CARBON FARMING, attualmente in via di approvazione,
E ANCHE NELLA PAC.

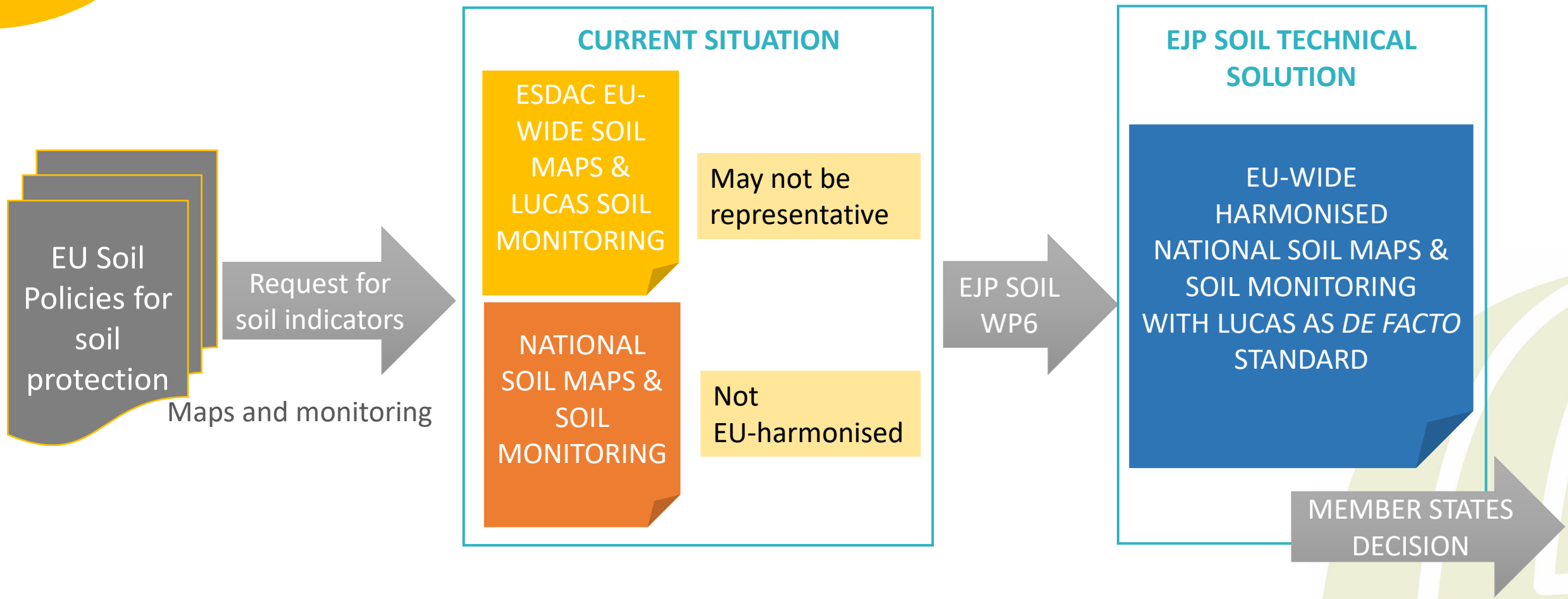
DA INDICATORI
ACTION BASED
= APPLICAZIONE DELLE MISURE
A RESULT BASED
= EFFETTI SUL SUOLO.

IL **SUOLO** SUPPORTA SIA LA **FUNZIONE DI PRODUZIONE AGROALIMENTARE** CHE **NUMEROSE ALTRE FUNZIONI AMBIENTALI**.
E' NECESSARIO IL COORDIAMENTO FRA POLITICHE AGRICOLE ED AMBIENTALI E RELATIVI MINISTERI ED ENTI.

EJP SOIL
European Joint Programme

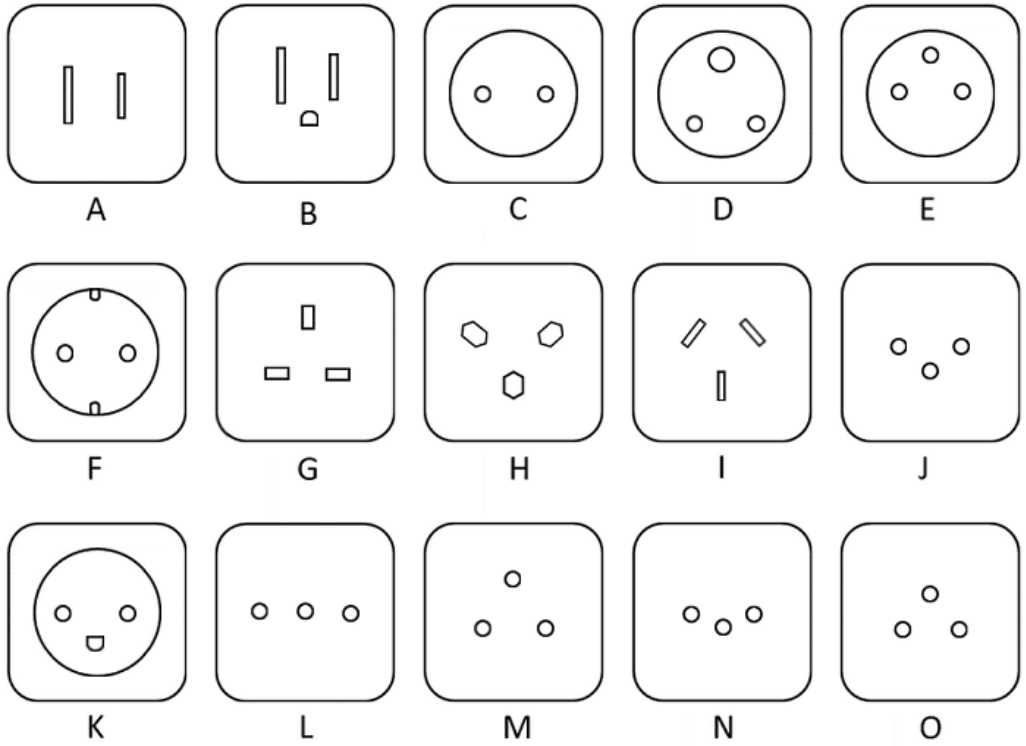
knowledge harmonization, organization & storage

WP6 - Supporting harmonised soil information and reporting



BUT STANDARDISED DATA IS STILL NOT HARMONISED DATA

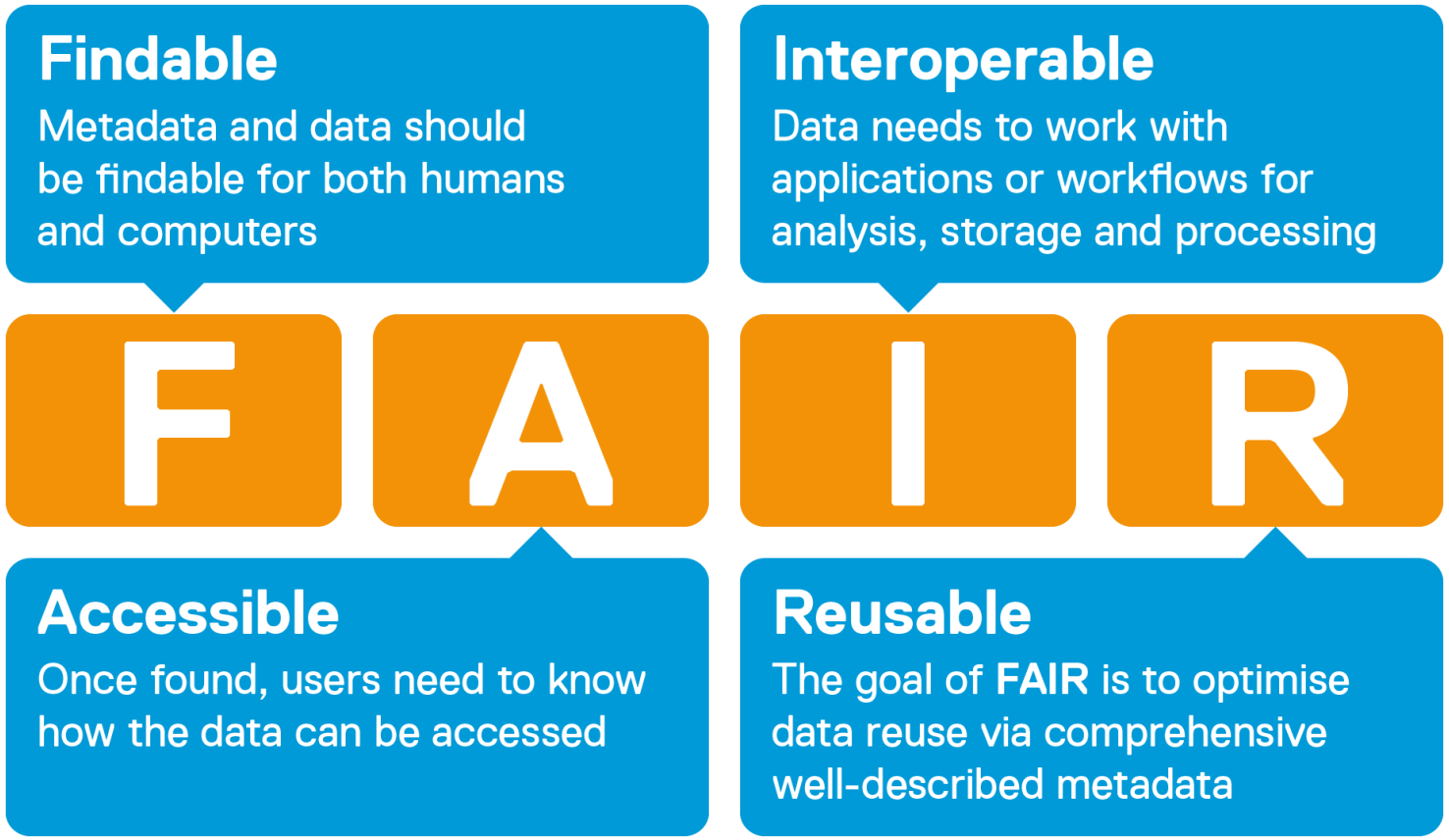
STANDARDISED DATA
explicit data = FAIR



HARMONISED DATA
transformed data to a common standard

Standardisation is describing data in the same way (agreed definitions, structure, format)
Harmonisation is translating data to the same units, lab methods, definitions, etc.

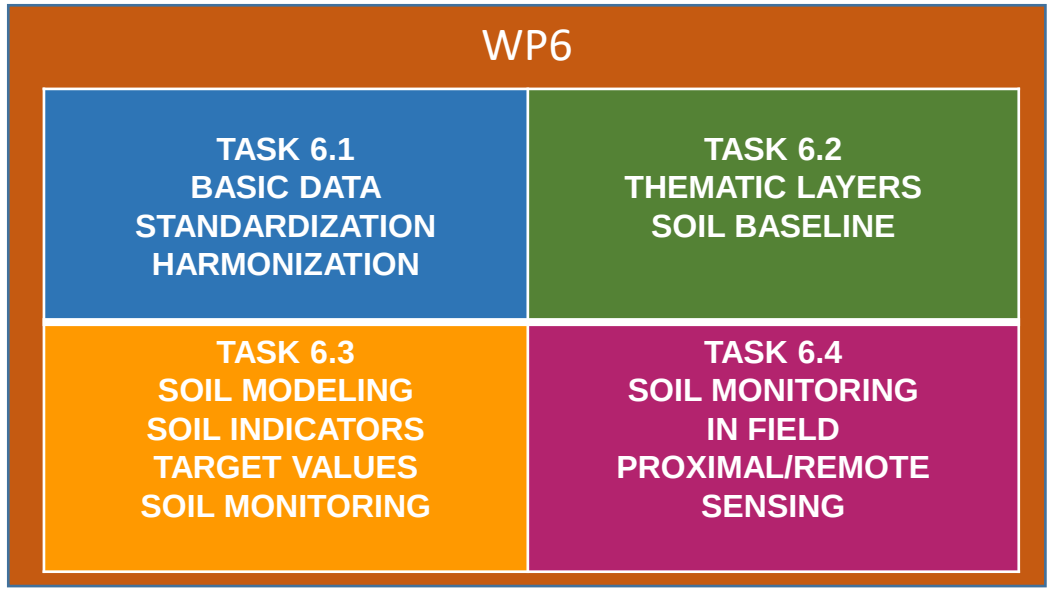
The data produced under European Research fundings must follow FAIR principles



We present here the technical contribution of EJPSOIL programme towards the implementation of these principles

https://ejpsoil.eu/soil-research/soil-data-monitoring-mapping-and-modelling

WP6 DONE AND TO DO



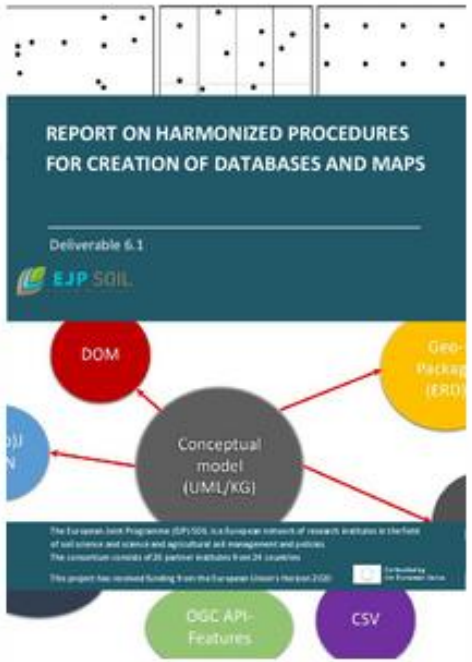
COMPLETED DELIVERABLES
D6.1 Report on harmonized procedures for creation of databases and maps
D6.2 Report on the national and EU regulations on agricultural soil data sharing and national monitoring activities
D6.3 Proposal of methodological development for the LUCAS programme in accordance with national monitoring programmes
COMPLETED – UNDER REVISION PROCESS BY REA AND JRC
D6.4 Software framework for a shared agricultural soil information system (confidential for EJP SOIL partners and commission services)
D6.5 Guidelines for accounting and mapping agricultural soil carbon, fertility and degradation changes at different scales
D6.6 Geodatabase on agricultural soil properties including SOC and agricultural soil functional properties related to water and nutrients
TO BE DONE
D6.7 Procedure for mapping of agricultural potential in different present and future climate conditions
D6.8 Final version of the agricultural soil information system for EU populated with the final version of project datasets

THE EJPSOIL CATALOGUE

THE EJPSOIL CATALOGUE FILLED WITH DATASETS

Results available at:
https://ejpsoil.eu/soil-data-monitoring-mapping-and-modelling

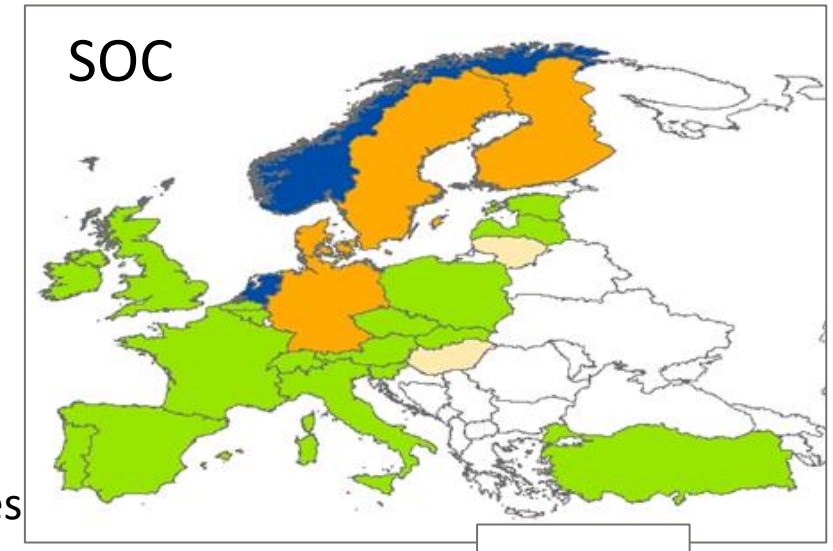
Deliverable 6.1 Report on harmonized procedures for creation of databases and maps

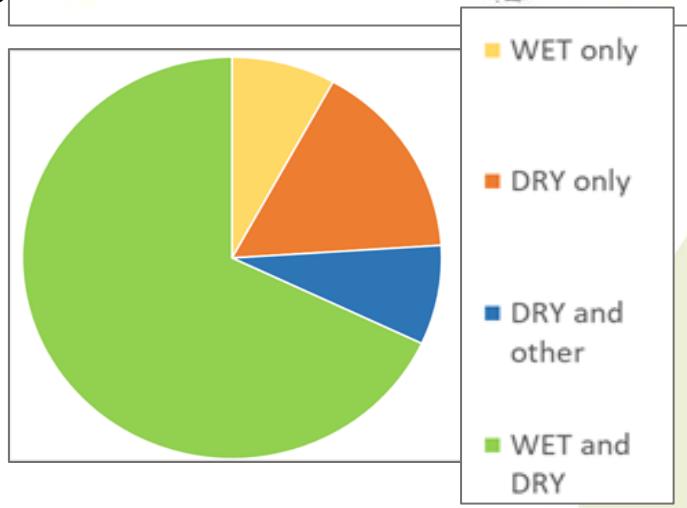


EJP SOIL Deliverable 6.1

https://ejpsoil.eu/fileadmin/projects/ejpsoil/WP6/EJP_SOIL_D6.1_Report_on_harmonized_procedures_for_creation_of_databases_and_maps__final.pdf

Table of content:





Cornu, S., Keesstra, S., Bispo, A., Fantappie, M., van Egmond, F., Smreczak, B., ... & Chenu, C. (2023). National soil data in EU countries, where do we stand?. European Journal of Soil Science, 74(4), e13398

EJP SOIL
European Joint Programme

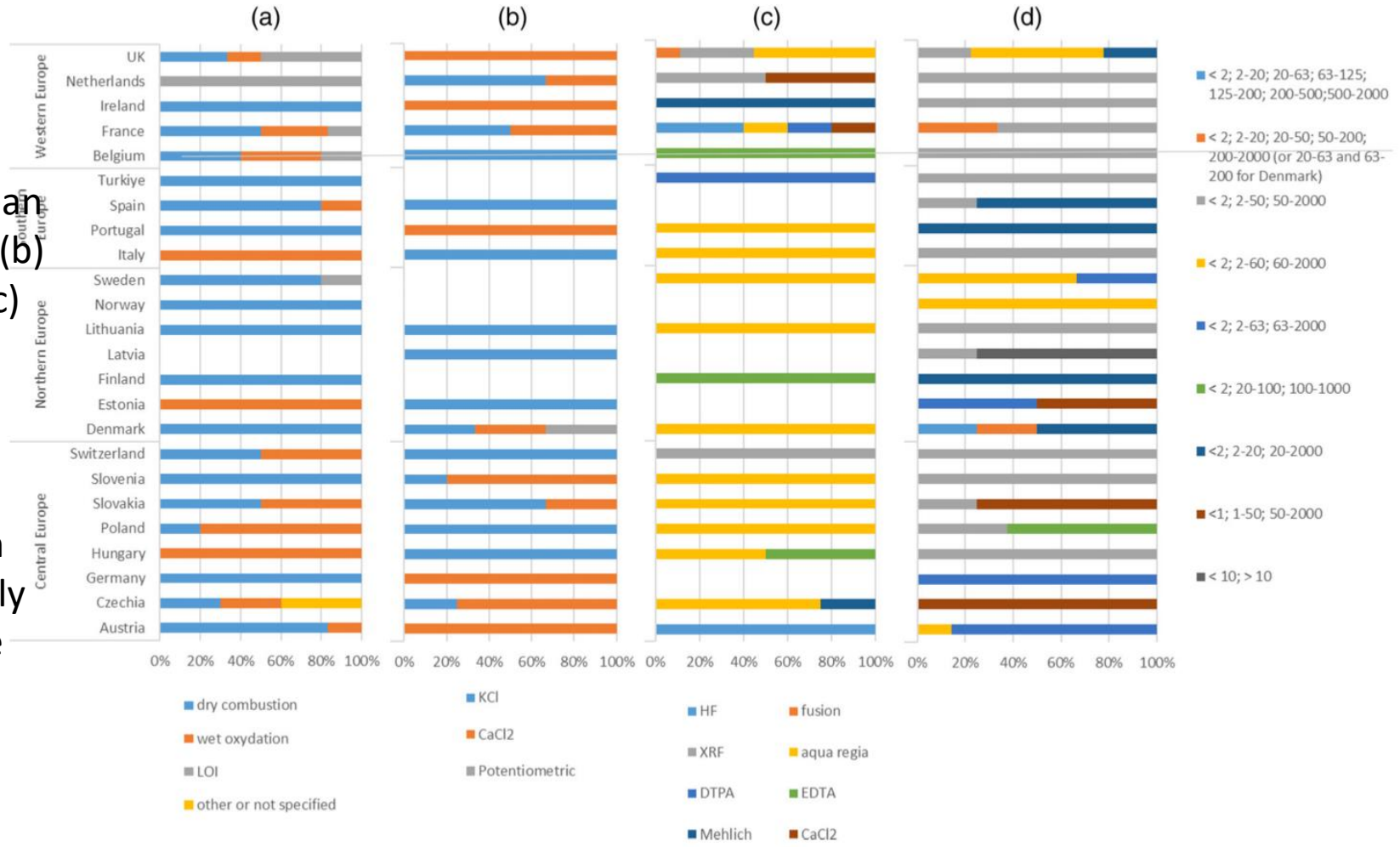
knowledge harmonization, organization & storage

National soil data in EU countries: where do we stand?

Variability of methods used in the databases of the different European countries for: (a) soil organic carbon; (b) soil pH measured in saline solution; (c) trace elements; and (d) particle size distribution.

The methods used by some countries vary because many databases were reported with different scale, while in other countries, such as Germany, only national homogenized database were reported.

LOI stands for loss on ignition.

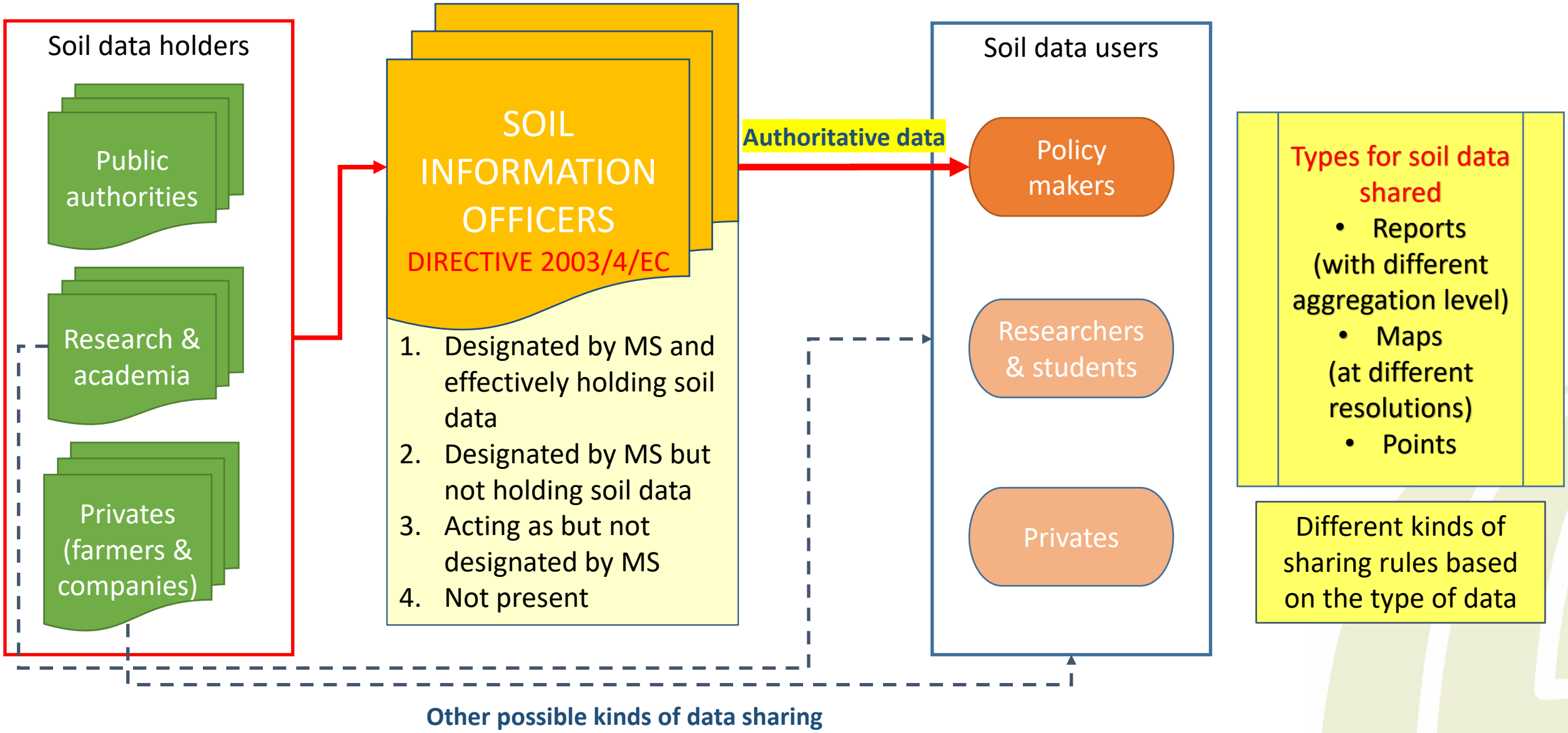


European Journal of Soil Science

Cornu et al. 2023. EJSS. DOI: 10.1111/ejss.13398

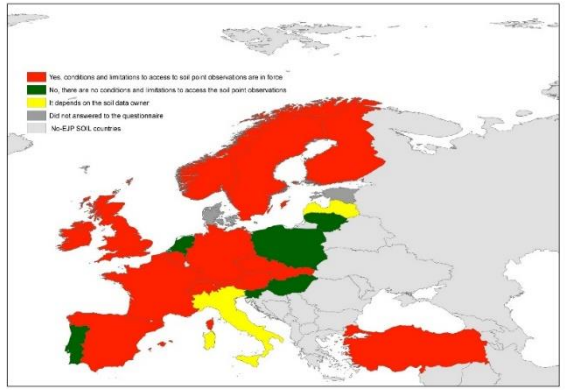
EJP SOIL European Joint Programme

SOIL DATA, DIFFERENT SOURCES, NEED OF SUPPORTING NATIONAL SOIL HUBS

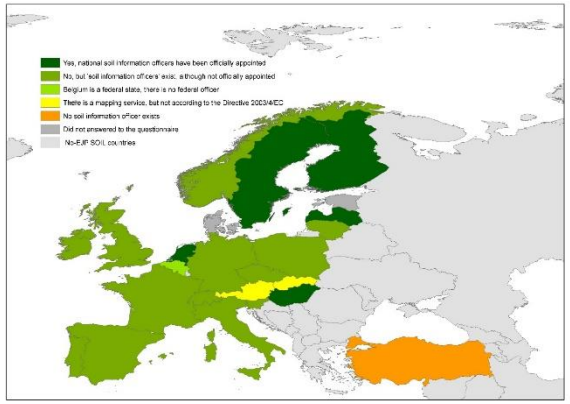


Deliverable 6.2 Report on the national and EU regulations on agricultural soil data sharing and national monitoring activities

Fantappiè, M., Peruginelli, G., Conti, S., Rennes, S., Le Bas, C., van Egmond, F., Smreczak, B., Wetterlind, J., Chenu, C., Bispo, A., Oorts, K., & Bulens, J. (2021). Report on the national and EU regulations on agricultural soil data sharing and national monitoring activities. Zenodo. https://doi.org/10.5281/zenodo.10014912



Sharing rules for gereferenced soil data and for elaborated/aggregated soil data (maps and reports)



Analyisis of soil data owners and soil information officers (officially appointed)

Recommendation One:

The point georeferenced soil data eventually will not be shared online, if there is not the declared consent from the data owner, which may imply obligatorily for some countries/regions/data-owners in the European Union, to get the consent from landowners. The consent for the disclosure of point georeferenced soil data may not be needed only in case of data on emissions of contaminant into the environment.

Recommendation Two:

The soil map data, that is, derived soil data resulting from mapping elaboration, can be published online given that the respective sharing rules are recognized in the metadata, such as intellectual property rights or specific licenses, as defined by the respective data owners.

Recommendation Three:

Stimulating the designation of official soil information officers and network of institutions at national and international level:

- promoting the networking of soil data holders, owners, and expert groups at national and supranational level.
- promoting the signing of specific mutual agreements for soil data sharing agreements between involved institutions and other stakeholders, public and private ones.
- promoting a uniform provision of services by supporting their implementation in case they are not provided yet.

Recommendation Four:

The suggestion is to adopt a ‘bottom-up’ approach in the soil mapping activities of the European Union involving the national/regional/federal-state soil data officers/services (official or not).

Policy brief near to be released.

ANALYSIS OF THE STATE OF IMPLEMENTATION OF THE INSPIRE REGULATION

IN EACH EJPSOIL COUNTRY … e.g. 4.21 Slovenia

Soil data shared in the INSPIRE portal for soil theme and comparative analysis in each MS.

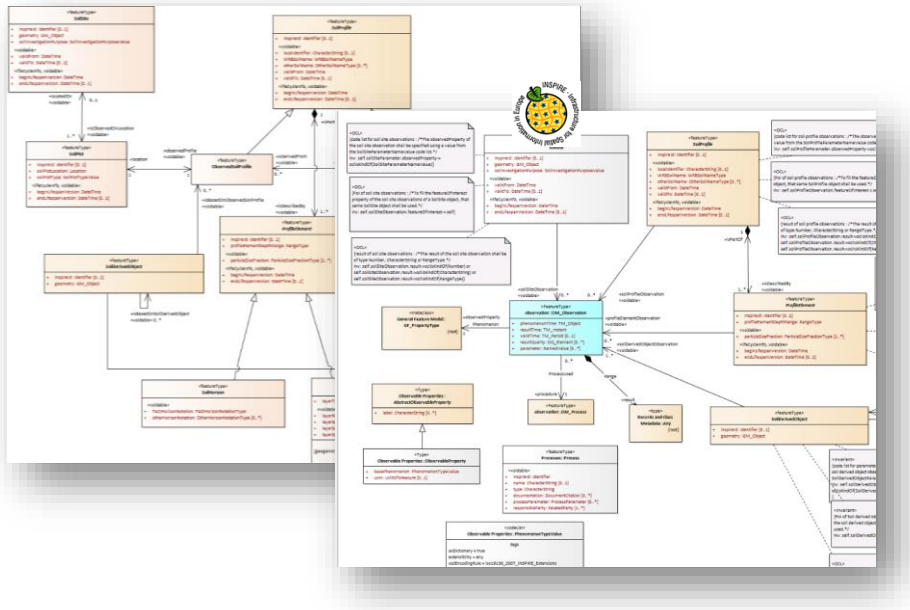
ONLY 74 DATASETS!!

Member State	**Directive 2003/04/EC** transposed	**Directive 2007/02/EC** transposed
State Structure Unitary State		**Soil ownership structure** Agricultural Institute of Slovenia, University of Ljubljana, https://arhiv.kis.si/pls/kis/!kis.web?j=EN; Biotechnical Faculty, https://www.uni-lj.si/academies_and_faculties/faculties/2013052914461802/.
INSPIRE contact point		Surveying and Mapping Authority https://www.gov.si/en/state-authorities/bodies-within-ministries/surveying-and-mapping-authority/
INSPIRE metadata portals and network services		https://eprostor.gov.si/imps/srv/slv/catalog.search#/home http://www.geoportal.gov.si/
INSPIRE Geoportal Number of published soil datasets		Other: 1
SOIL DATA SHARING POLICIES points		**No access constraints**
SOIL DATA SHARING POLICIES polygons		The access is given depending on the data collection framework or participation in research activities/projects.
SOIL DATA SHARING POLICIES grids		The access is given depending on the data collection framework.

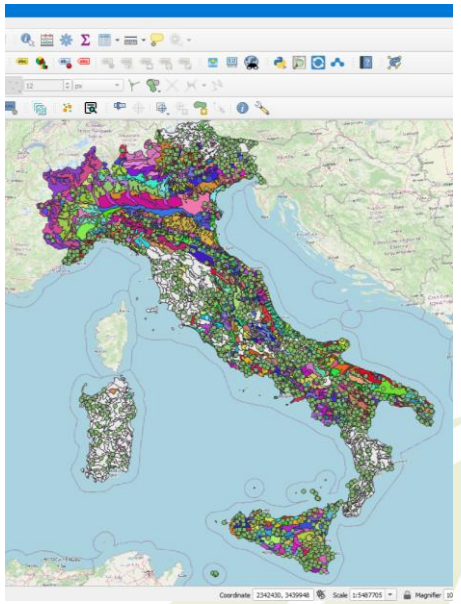
Deliverable 6.4 Software framework for a shared agricultural soil information system –

Focus on:

- cross-border data sharing
- simplified and more usable (INSPIRE) deliveries
- operational efficiency and ease of use

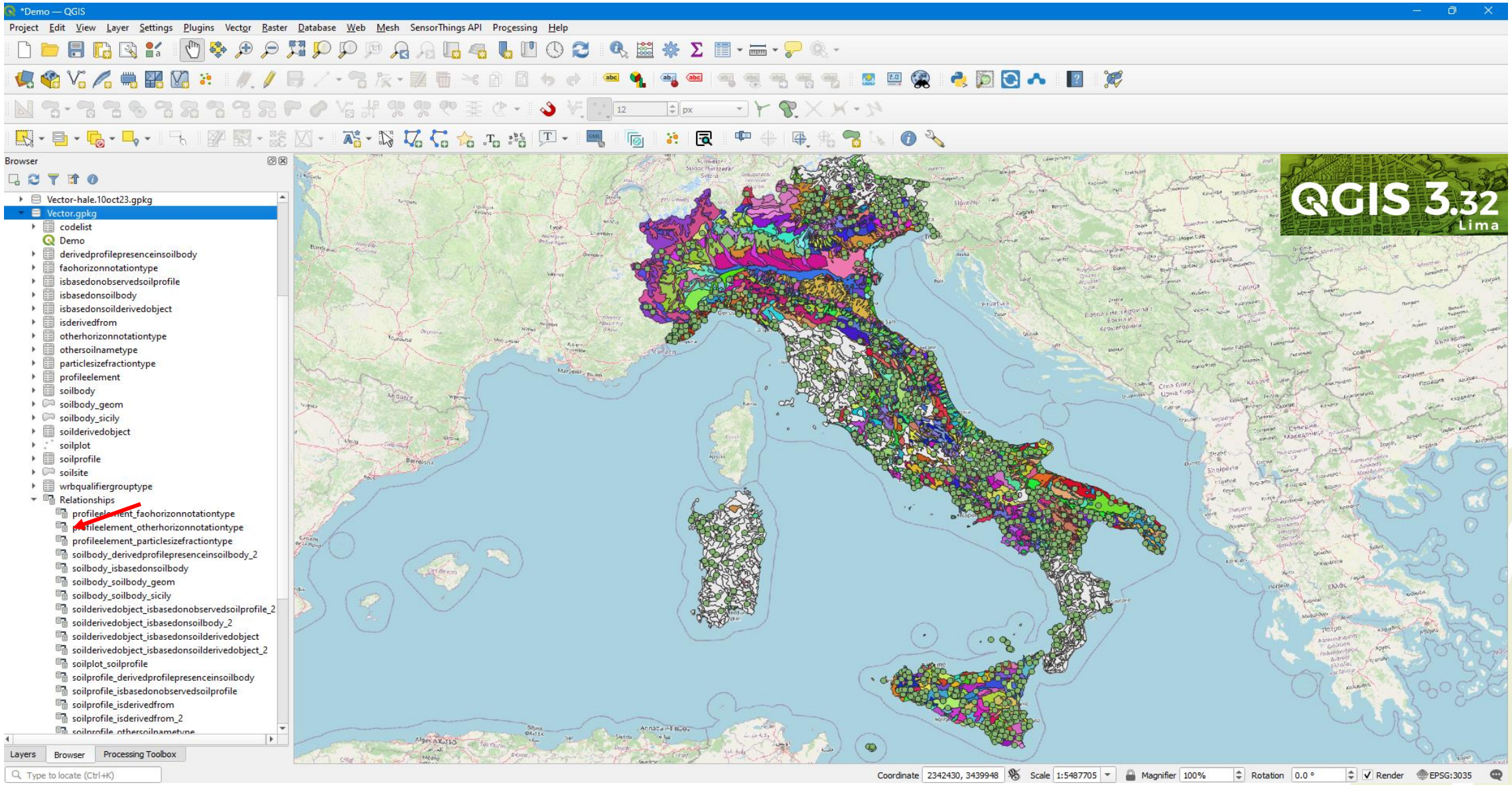


- Lightweight
- Performant in GIS environments
- Efficient with limited connectivity and bandwidth

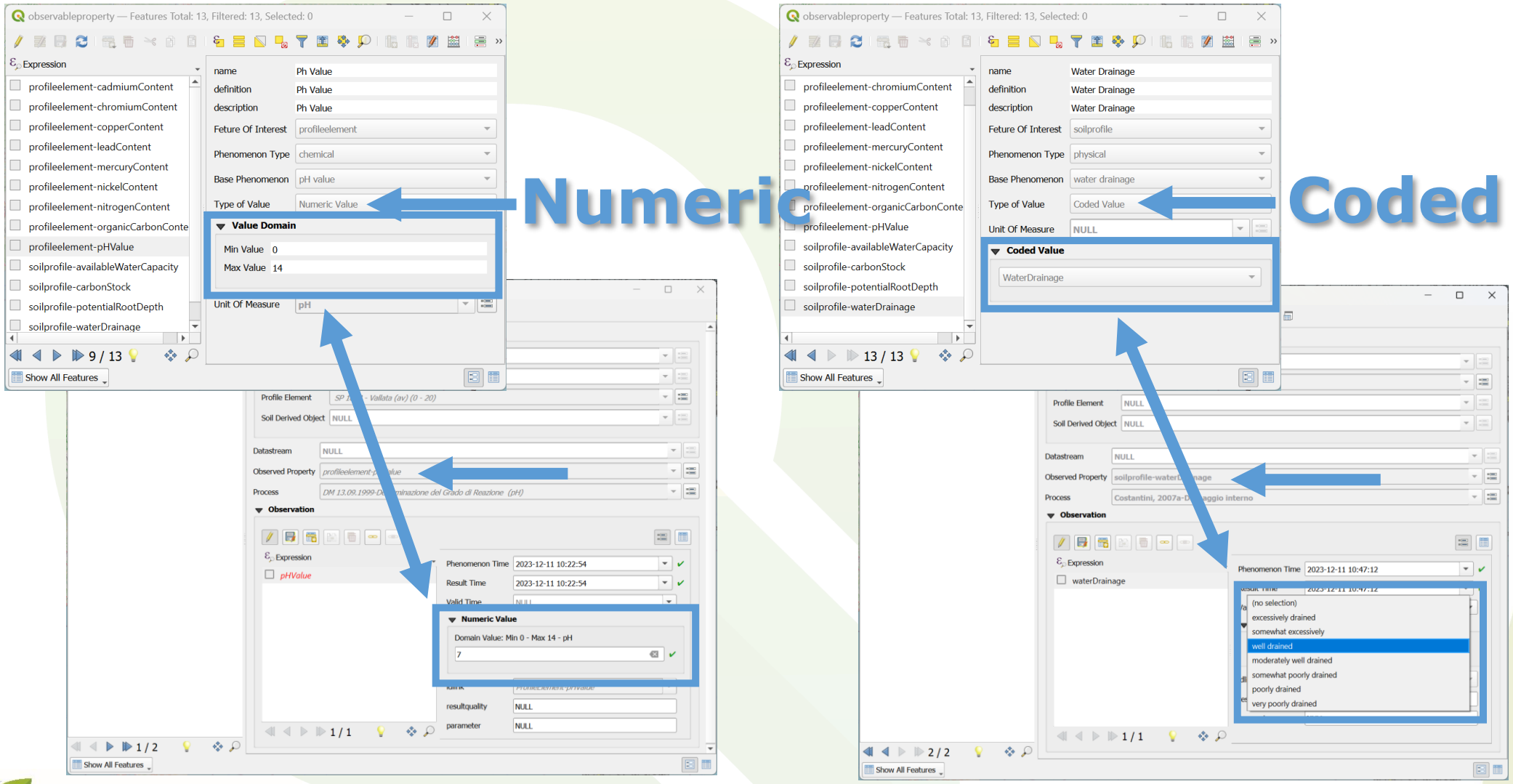


QGIS 3.32 Lima

Reusable, readable inside GIS.



Triggers for quality check in the soil data upload



D6.6 Geodatabase on agricultural soil properties including SOC and agricultural soil functional properties related to water and nutrients

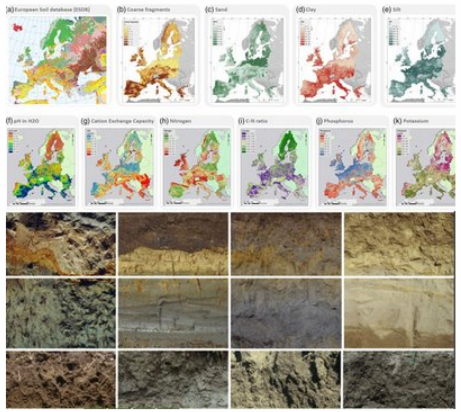
MAKE DATA FINDABLE

EJP SOIL
European Joint Programme

About EJP SOIL | Research | Science to policy | Knowledge Sharing Platform | GM & Annual Science Days

EJP SOIL › Research › Soil data & Monitoring, mapping and modelling

Soil data & Monitoring, mapping and modelling



Search the Soil data catalogue system

The soil data catalogue is a user friendly search experience.

The catalogue contains:

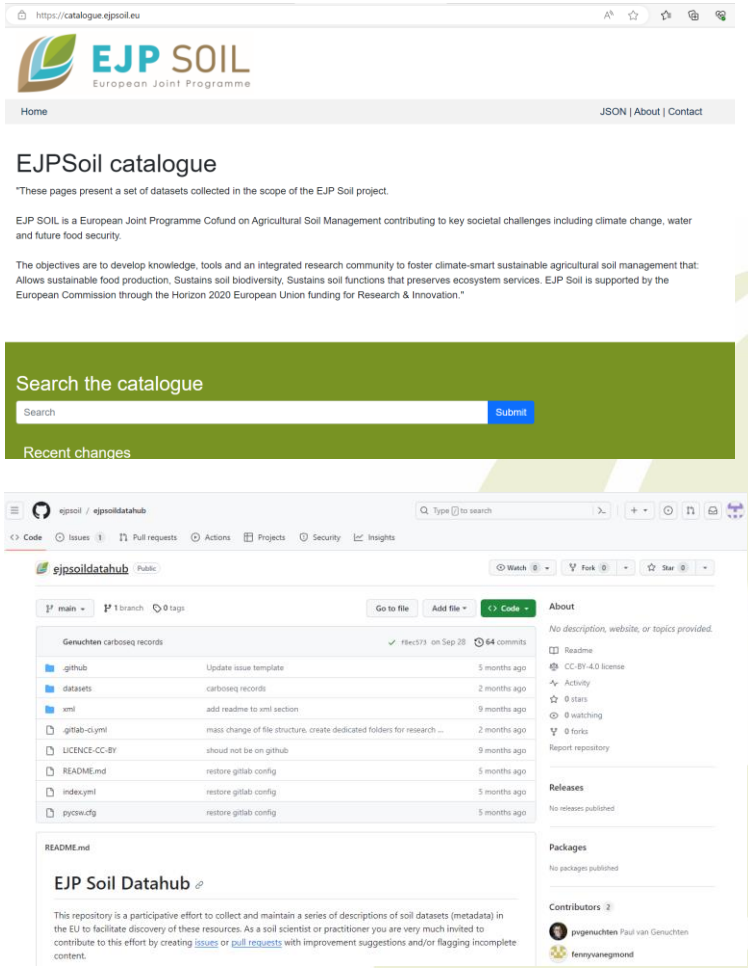
- Data products produced in the EJP SOIL and in the wider Soil community
- An overview of national datasets

Visit the csoil data catalogue via one of the following two points of access:

- The searchable interface: https://catalogue.ejpsoil.eu
- A GIT repository GitHub - ejpsoil/ejpsoildatahub (The source of the metadata).

An aspect of the catalogue system is a minimal metadata template in Excel, developed to provide a minimalistic approach to bulk loading records into the catalogue. Alternative available bulk loading initiatives are importing from CSW and DOI (harvesting).

In case you identify potential improvements, create an issue on the git repository or submit an improvement.



Metadata catalogue

- Records entered based on the stocktake of D6.1 in 2020 on national soil and soil management datasets: [Soil data & Monitoring, mapping and modelling (ejpsoil.eu)]
- Searchable with keywords, countries, projects

EJP SOIL
European Joint Programme

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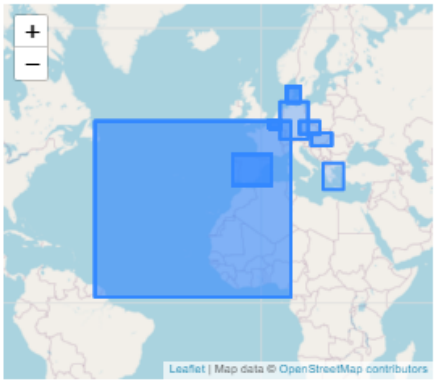


Country

> Belgium
> Czech Republic
> Denmark
> Estonia
> Europe
> France
> Germany
> Greece
> Hungary
> Ireland
> Italy
> Latvia
> Lithuania
> Netherlands
> Norway
> Poland
> Portugal
> Slovakia
> Slovenia
> Spain
> Sweden
> Switzerland
> Turkey
> UK

EJP Soil

> AGROECOseqC
> CLIMASOMA
> CarboSeq
> EJP Soil
> EnergyLink

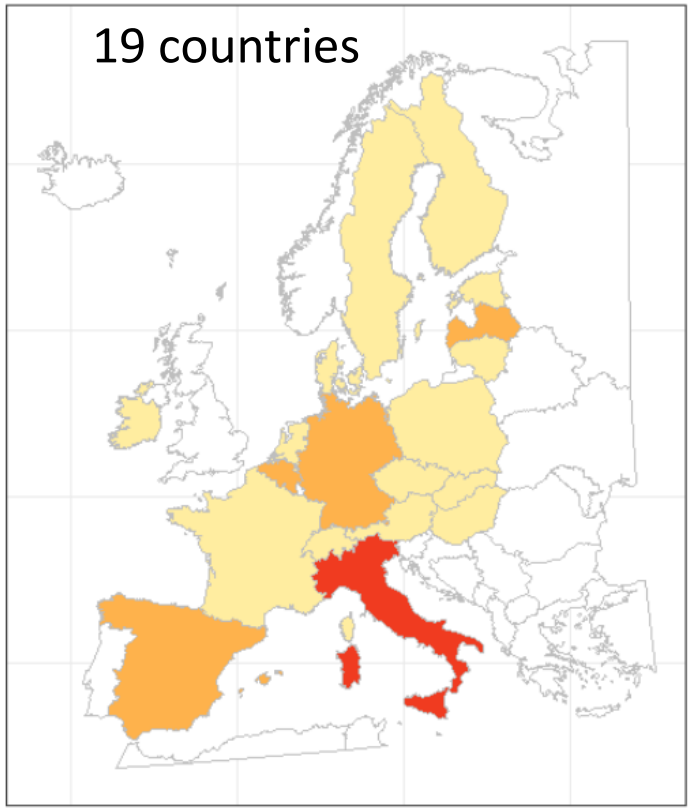
Title	Type	Date
Potential soil erosion map of Flanders modeling...	dataset	2023/11/16
WRB Soil units 40k borehole/profile...	dataset	2023/11/16
Soil Organic Carbon Stock Maps for Belgium Soil Organic Carbon Stock Maps for Belgium: mean (1 km grid)...	dataset	2023/11/16
Bodemprofielen kartering Belgische bodemkaart Location of soil profiles mapping Belgian soil map...	dataset	2023/11/16
Soil Organic Carbon Stock Maps for Belgium (40m grid) borehole/profile depth intervals of the GSOC map (0-30cm)...	dataset	2023/11/16
Carbiosol map Top soil measurement...	dataset	2023/11/16
Digitale bodemkaart van het Vlaams Gewest: bodemtypes Digital soil map of the Flemish Region: soil types. In accordance with the classification system used: morphogenetic for inland Flanders (substrate, texture class, drainage class, profile development group, phase and variant)...	dataset	2023/11/16
Soil Organic Carbon Stock Maps for Belgium Soil Organic Carbon Stock Maps for Belgium: mean (1 km grid)...	dataset	2023/11/16
Potentiële bodemerosiekaart per perceel The potential soil erosion map per parcel is based on the 2017 parcel map. The erosion calculation is based on the revised universal soil loss equation or R.U.S.L.E...	dataset	2023/11/16
Potential soil erosion aggregated for a grid of 1 km by 1 km in Flanders The potential soil erosion aggregated for a grid of 1 km (ton/ha)...	dataset	2023/11/16
Soil map of Flanders (1:20.000) borehole/profile...	dataset	2023/11/16
Digital Map of Walloon Soils Whole profile by soil horizons...	dataset	2023/11/16
Bodemafdekkingskaart 2015 (BAK), 5 m resolutie (Soil sealing rate) ...	dataset	2023/11/16
Soil Organic Carbon Stock Maps for Belgium Soil Organic Carbon Stock Maps for Belgium: mean (40 m grid)...	dataset	2023/11/16
WRB Soil Units 40k WRB Soil Units 40k: Soil map of the Flemish Region according to the international soil classification system World Reference Base on a scale of 1: 40,000...	dataset	2023/11/16
DOV soil database for Flanders	dataset	2023/11/16

EJP SOIL
European Joint Programme

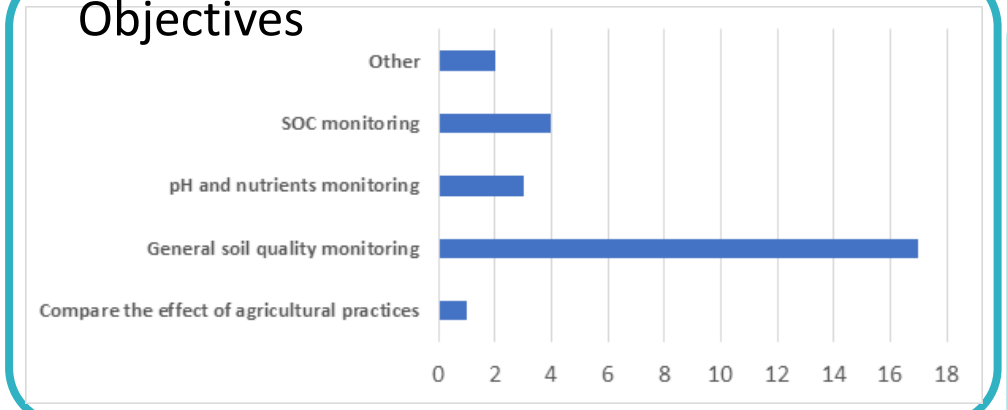
knowledge harmonization, organization & storage

Taking stock: Existing national soil monitoring programmes

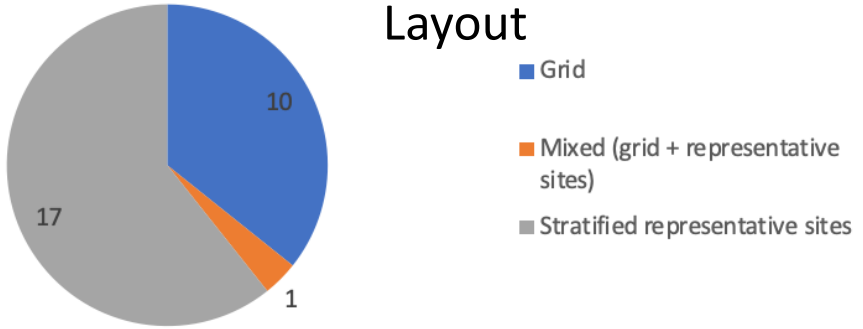
19 countries



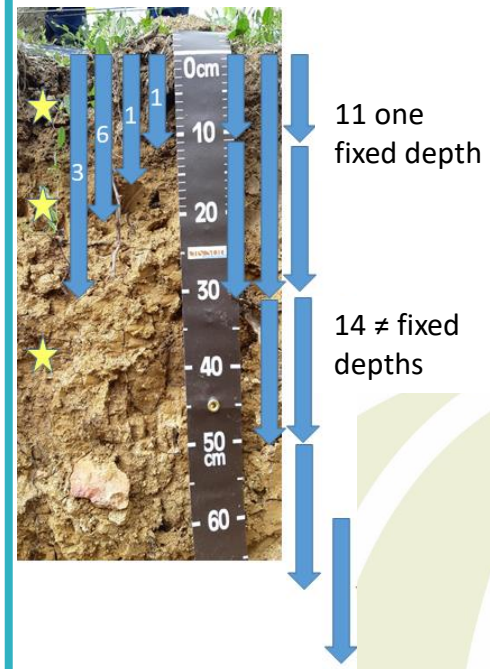
Objectives



Layout



Sampling depths



Soil monitoring systems with very diverse protocols and with different soil parameters monitored

EJP SOIL A. Bispo et al. Deliverable D6.3, 2021

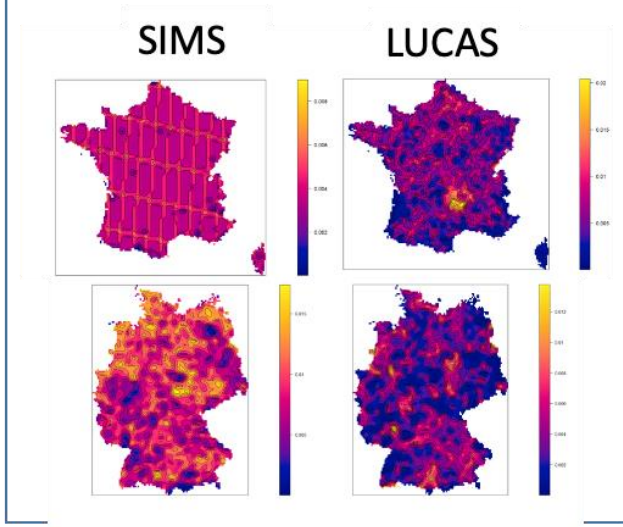
➥ ongoing LUCAS – EJP SOIL National soil monitoring systems intercomparison

knowledge harmonization, organization & storage

Comparison of national soil monitoring systems and LUCAS Soil

1

- Site selection heterogeneity…



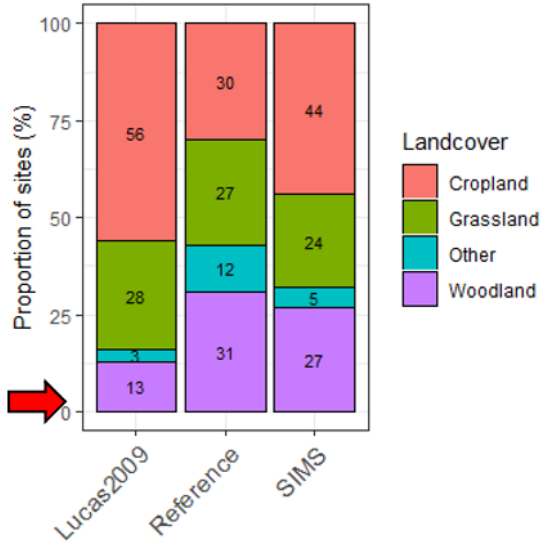
Gaps in Lucas Soil sampling in some regions (here France and Germany)

** Dark blue surfaces: lower point density*

2

… Impacting land cover representativity…

Over-representation of cropland, under-representation of woodlands (e.g. in France and Italy) compared to Lucas Survey reference

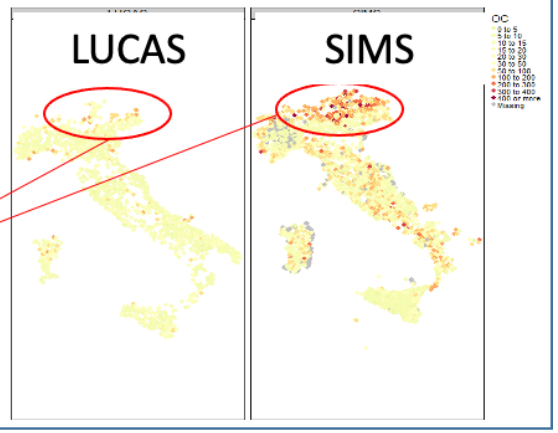


3

… And soil properties distribution.

- Significant differences in carbon content :
  - Over-estimated in French forests (+ 30%)
  - Under-estimated in Italian forests (- 50%)

Missing locations with high carbon content in Italy



- Soil health assessments depend on datasets
- Challenge to assemble the datasets
- Communicate on consequences of sampling on evaluations

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European Joint Programme

Froger et al. submitted

Slide: © Claire Froger

knowledge harmonization, organization & storage

SOIL MONITORING SYSTEMS Challenges & recommendations towards harmonization

- Differences in sampling strategies, designs and protocols make soil data difficult to compare across countries and with LUCAS Soil
- Countries do not want to change their protocols but could add new monitoring sites
- Harmonization options of soil monitoring systems and LUCAS Soil exist, such as developing transfer functions
- Major differences between a national soil monitoring system and LUCAS both on sampling strategy and measured soil properties can impact soil quality and soil health assessment

	Advantages	Limitations	EJP SOIL progresses
Compare National and LUCAS datasets	Can identify the main differences and similarities between national and EU datasets	Will require statistical skills to be tested and developed.	Test within EJP SOIL is ongoing and preliminary results are described in the paragraph below.
Develop transfer functions for data produced with national and LUCAS sampling protocols and/or analytical methods	Can improve the use of national and LUCAS datasets together.	Will require time and money for analysis and training (e.g. for sampling).	Tests within EJP SOIL are ongoing in collaboration with the LUCAS Soil programme. Taking the opportunity of LUCAS 2022 campaign, EJP SOIL partners are currently analysing soil samples collected by LUCAS samplers to compare several analytical methods. Some partners also sampled according to the LUCAS protocol in order to compare not only analytical methods but also sampling protocols. Results are expected in 2024.
Identify and test statistical methods to combine national and LUCAS datasets or maps		Will require statistical skills to develop and test appropriate methods.	Tests within EJP SOIL are ongoing, e.g. on data collected with different sampling strategies - included in EJP SOIL WP6 work programme.
Develop framework for interpretation approaches		Will require pedological and statistical skills to develop and test methods.	Tests within EJP SOIL are ongoing- included in EJP SOIL WP6 work programme and connected to SERENA project.

Table 1. Analysis of the harmonisation's options

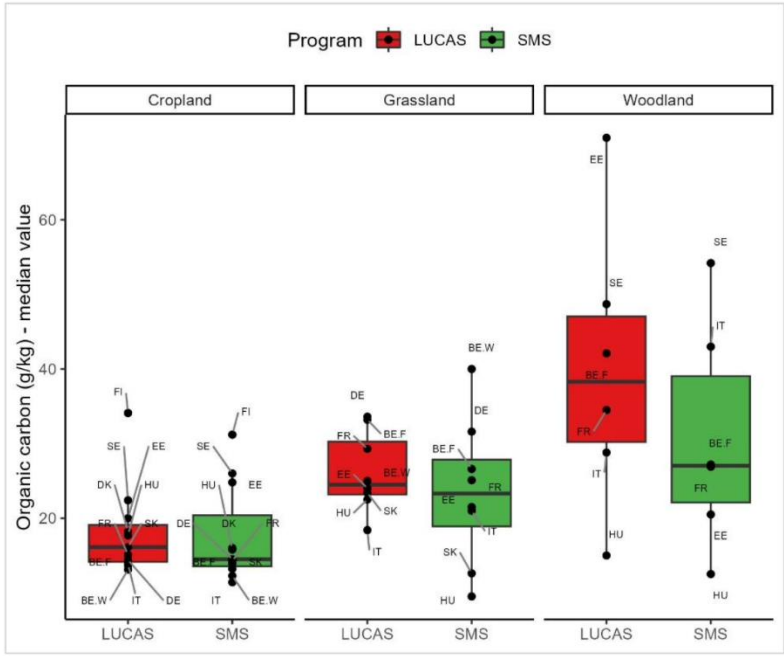


Figure 1. Comparison of measured soil Organic Carbon content between the LUCAS and national Soil Monitoring System (SMS) campaigns depending on land cover for ten countries (BE: Belgium with BE.F: Flanders and BE.W: Wallonia; DE: Germany; DK: Denmark; EE: Estonia; FI: Finland; FR: France; HU: Hungary; IT: Italy; SE: Sweden; and SK: Slovakia)

Mason et al. 2023. Policy brief

https://ejpsoil.eu/

Soil indicators IN EUROPE – the role of Research

EJP SOIL SIREN

Inventory of current indicator systems

EEA

Soil monitoring in Europe – Indicators and thresholds for soil health assessments - 2022

EJP SOIL MINOTAUR

Prioritizing biodiversity indicators

EJP SOIL SERENA

Common definitions, thresholds inventory/proposal

EJP SOIL European Joint Programme WP6

WP6: "D6.5 Guidelines for accounting and mapping agricultural soil carbon, fertility and degradation changes at different scales"

EU MISSIONS SOIL DEAL FOR EUROPE

BENCHMARKS & AI4SOIL projects

updates

EU Soil Strategy

EU Soil Health Law

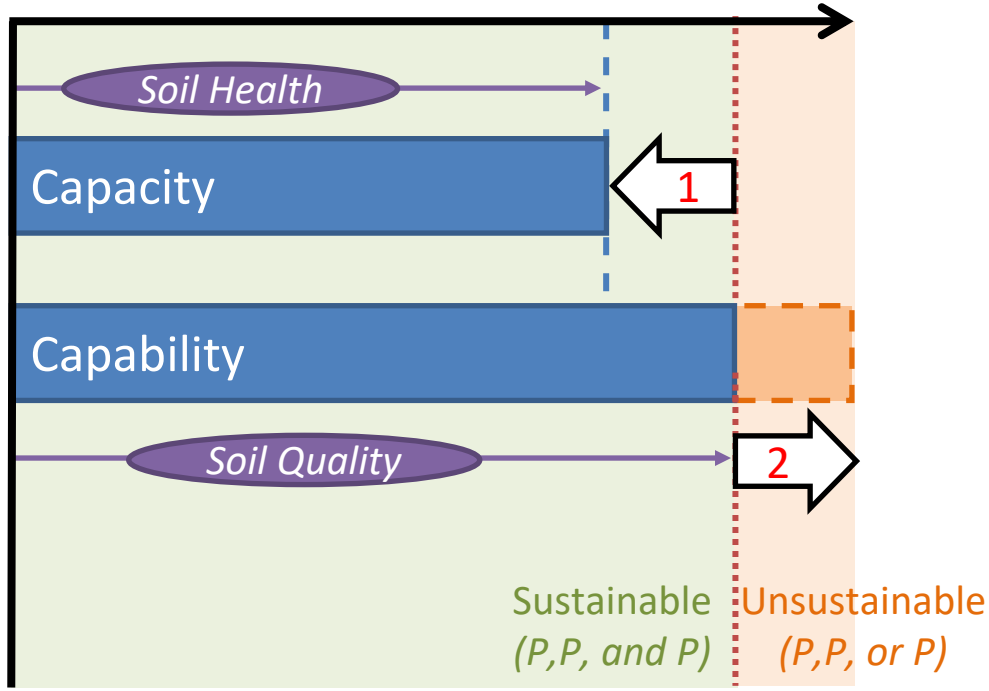
GSP ISAF soil health indicators

GLOBAL SOIL PARTNERSHIP

Soil health and soil quality … and the criteria to select soil indicators (descriptors/properties)

SIREN

Ecosystem services provision level



An extract from the introduction of Deliverable D6.5 under review.

As discussed by EEA report (2023), soil quality is described using soil indicators. These are observed and evaluated soil properties, which can indicate the degree to which soils fulfil expected functions as needed for the wellbeing of crops, livestock, and consequently, human society.

Within EJP SOIL, while soil quality is the potential capability of a soil given soil type and land use, soil health is its actual capacity to deliver goods and services (Faber et al 2022), that is the current state.

Whatever the definition, important **selection criteria for indicators**, **and the underlying soil properties**, are:

1) their responsiveness to management and changed environmental conditions;
2) they must also correlate with soil functions and the environmental processes affected by disturbances and change.

https://ejpsoil.eu/soil-research/siren

Coordination for Italy Vanino CREA
silvia.vanino@crea.gov.it

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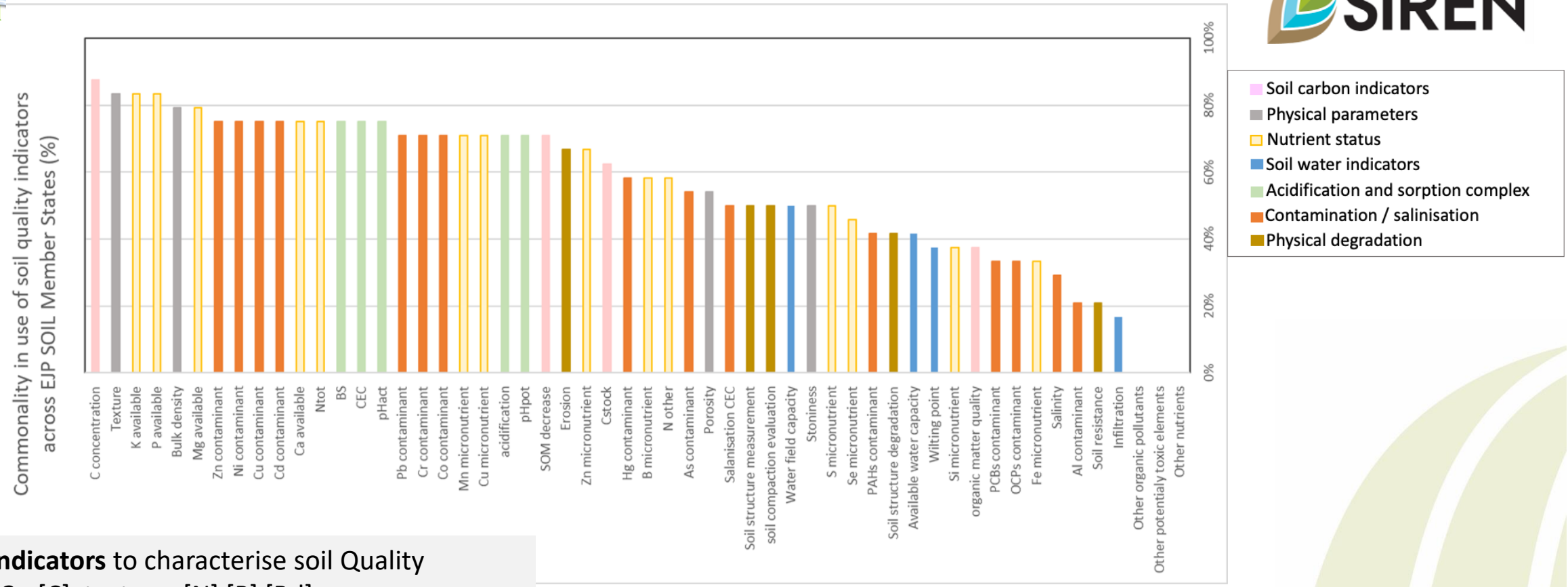
Faber et al. 2021
https://ejpsoil.eu/fileadmin/projects/ejpsoil/Policy_briefs/SIREN/SIREN_Policy_brief.pdf

knowledge development

Taking stock of soil indicators and values used by Member States



- **68 indicators** to characterise soil Quality
- **Top 3** : [C], texture, [N] [P] [Bd]
- **Biological indicators** still rarely used
- **Organic Pollutants** not used
- **Few reference, target and threshold values**

Faber et al. SIREN final report, 2022
https://ejpsoil.eu/fileadmin/projects/ejpsoil/Policy_briefs/SIREN/SIREN_Policy_brief.pdf

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Coordination for Italy Vanino CREA
silvia.vanino@crea.gov.it

Deliverable 6.5 Guidelines for accounting agricultural soil carbon, fertility and degradation changes at different scales

SOIL FERTILITY INDICATORS	SOIL DEGRADATION INDICATORS
SOC	SOC DECLINE
SOIL NUTRIENTS AND NUTRIENTS BALANCE	SOIL NUTRIENTS DECLINE AND UNBALANCE
ECEC AND EXCHANGABLE BASES	SODIFICATION
pH	ACIDIFICATION
ELECTRICAL CONDUCTIVITY	SALINIZATION
SOIL WATER CONTENT	SOIL ARIDITY
SOIL ROOTING DEPTH	SOIL EROSION
SOIL BIODIVERSITY	SOIL BIODIVERISY LOSS
SOIL STRUCTURE	SOIL COMPACTION
	SOIL SEALING
	SOIL CONTAMINATION

In the revised version

1. **Why measuring ?**
2. **How to measure ?**
3. **Do we have existing thresholds?**
4. **Recommendations**

In the first delivered version

1. AVAILABLE THRESHOLDS AND TARGET VALUES USED IN REPORTING/INTERPRETING (BASED ON LITERATURE REVIEW AND/OR SIREN-EEA REPORTS; In this paragraph we will describe what is available in previous stocktakes / on going projects... Or past projects (e.g. https://www.isqaper-project.eu/)
2. MODELS AVAILABLE TO DETECT THEIR CHANGES IN RELATION TO CLIMATIC AND MANAGEMENT FACTORS;
3. MONITORING THROUGH PS/RS TECHNIQUES (LIMITATION, ACCURACY, APPLICABILITY, COSTS...);
4. SCALE EFFECT: LEVEL OF DEPENDANCE TO REPORTING SCALE.
5. FINAL RECOMMENDATIONS What we will recommend as a relevant way of accounting for changes in soil fertility and degradation.

UPDATED AND REVISED IN MARCH AFTER JRC REVIEW BUT THE RESULTS ALREADY HAD AN IMPACT

knowledge application

Proposed shortlist "minimum dataset" for harmonised soil quality monitoring across Europe

SIREN

Criteria:

- EU Policy-relevant
- >50% MS
- >30% sci. literature
- Appl. in EU projects

Biodiversity data

- Structural
- Functional

Policy Indicator	Soil Quality Indicator
Soil physical condition	Texture, Porosity, Bulk density
Soil fertility	C concentration Total N P K pH
Erosion evaluation	Based on calculation
Salinity	Electric conductivity
Contamination	Heavy metal trace elements
Other contaminants	*Recommended to be included in a first tier **
Soil biodiversity	
Water regulation	

** Based on our selection strategy, we observed significant omissions regarding indicators for soil biodiversity, organic contamination and water regulation/filtration. As soil condition data in these areas are called for by policies and stakeholders and (standardised as well as novel) methods are scientifically available, we recommend to also include relevant indicators in this 1st tier minimum dataset. Based on our stocktake and reviews it is yet impossible to select any without making subjective choices, which we wanted to avoid.*

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silvia.vanino@crea.gov.it

Faber et al. 2021
https://ejpsoil.eu/fileadmin/projects/ejpsoil/Policy_briefs/SIREN/SIREN_Policy_brief.pdf

From the D6.5 conclusions …

Analysing the different soil indicators, is clear that it will be arduous to define soil districts, as required by the Soil Monitoring Law proposal, which could satisfy the monitoring requirements of all the soil indicators.

For example, it is possible to define **at least 4 main groups of indicators**:

1) indicators linked to chemical/physical/biological properties of soils;
2) indicators linked to hydraulic properties, therefore linked to management at watershed level;
3) indicators defined by the loss of available soil surface (sealing);
4) soil contamination.

Each of these groups may have different monitoring requirements and/or may require different stratification and thus soil districts defined in different ways.

Finally, there is **reasonable agreement between our review and the indicators proposed by the Soil Monitoring Law**, the EUSO soil dashboard and EEA (2023), **except for certain indicators (e.g. biodiversity, soil sealing, AWC)** and for threshold values that should be discussed and adapted to local conditions.

and the revised version of SML

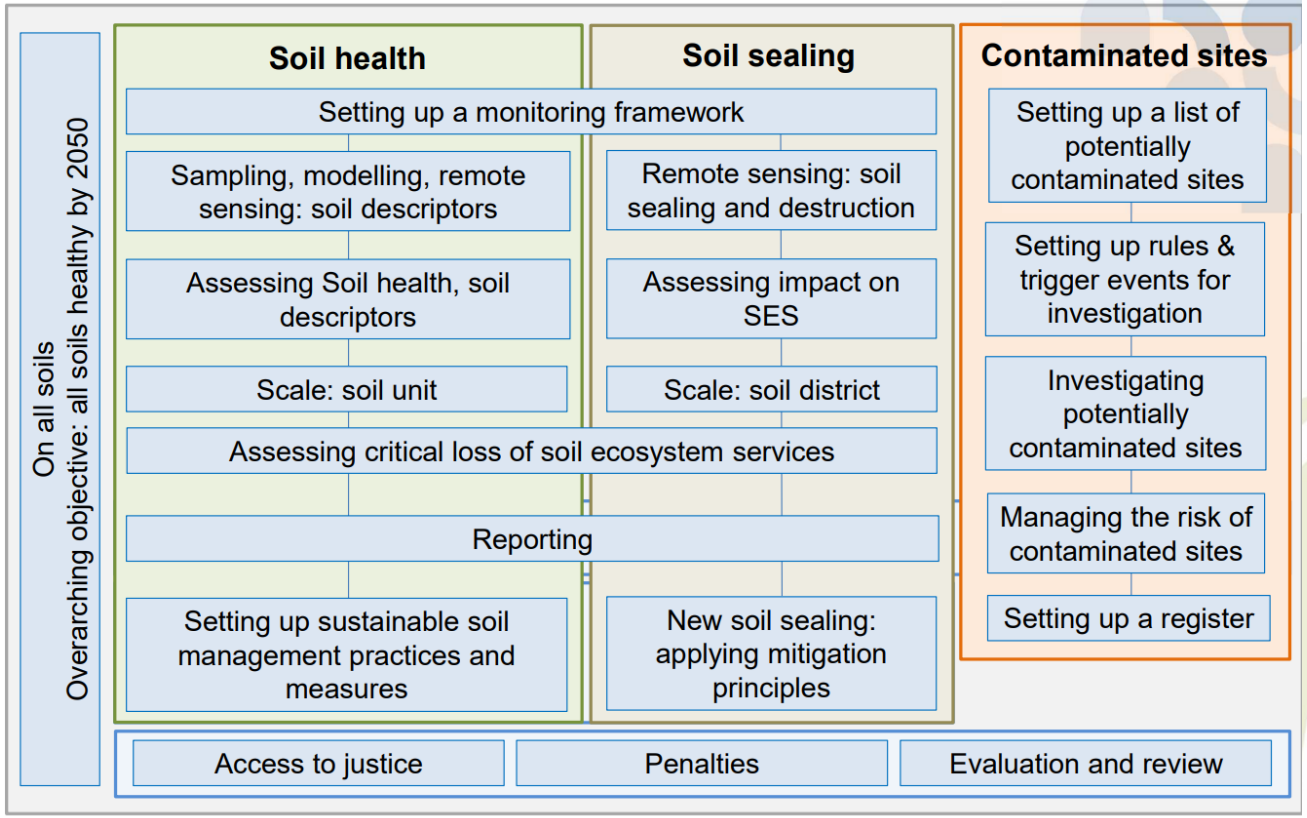

Table 5 2 Recommended indicators for common set of soil parameters.

Soil parameters	Soil Quality Indicator	Frequency	Depth and scale	Costs (to be included)
SOC				
	SOC/SOCexp (∅SML).	Can be measured every 5 y since not that expensive but changes will only be detected after 10 y or more	Topsoil and subsoil /Field	10 to 30 € for mesuring SOC 50 to 80 € for mesuring SOC stocks (bulk density)
	SOC/SOCmax (∅SML).	10 y	Topsoil and subsoil /Field	
	Delta SOC content (∅SML).	10 y	Topsoil and subsoil /Field	
	Delta SOC Stock (∅SML).	10 y	Topsoil and subsoil /Field	
Nutrients	total N (⊕SML)	10 y	Topsoil/Field	10 to 25 €
	available P (⊕SML)	5-10 y	Topsoil/Field	10 to 40 € (usually done with other nutrients)
	P stocks (∅ SML)	10 y	Topsoil and subsoil /Field	10 to 80 € (usually done with other macro-nutrients)

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⊕ SML : agreement with SML proposal, ∅ SML : disagreement with SML proposal

Soil parameters	Soil Quality Indicator	Frequency	Depth and scale	Costs (to be included)
Contamination	Trace Elements (⊕ SML)	10 y	Topsoil and subsoil /Field	Around 80 € for a set of trace elements (without As or Hg that will require 20 to 50 extra €)
	Selected organics - Common methodology for selection (⊕ SML)	5 y for emerging substances and 10 y for banned ones	Topsoil/Field 0-5 and 0-10 cm may be preferred.	Depends on the group of substances (100-500 € for each group depending on the status of the method)
Soil structure	Dry bulk density (⊕ SML)	5 y	Topsoil and subsoil /Field	Depends on soil nature for the sampling time, more related to man costs
Sealing	Soil sealing expressed as % of sealed area per total area (⊕ SML)	1-3 y	Not relevant	Variable depending on methods used and on the area to be investigated
Erosion	Soil loss rate (⊕ SML)	Calculation per year	Depends on erosion process	Made by modelling since field measurements are labour intensive

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⊕ SML : agreement with SML proposal, ∅ SML : disagreement with SML proposal

Table 5 2 Recommended indicators for common set of soil parameters.

Soil parameters	Soil Quality Indicator	Frequency	Depth and scale	Costs (to be included)
CEC/ECEC/Exc Bases	CEC (∅ SML)	Intial campaign	Topsoil and subsoil /Field	20 to 60 €
	ESP (Ex Bases) (∅ SML)	5 y	Topsoil and subsoil /Field	20 to 60 €
pH	pH in water 1:5 soil:water mixture (⊕SML)	5 y	Topsoil/Field	10 to 30 €
Electrical conductivity	ECe (⊕SML)	5 y	Topsoil and subsoil /Field	5 to 15 €
AWC	waterflow at the outlet of river basins in relation to rainfall intensity (∅ SML)	5 y	Basin	15 to 65 € er sample and several samples will be needed depending on the size of the investigated basin
	soil water infiltration rate and permeability **(Ksat)** (∅ SML)		Topsoil and subsoil /Field	Less than 50 €
	soil structure stability (∅ SML)		Topsoil and subsoil /Field	Less than 50 €

EJP SOIL
European Joint Programme

⊕ SML : agreement with SML proposal, ∅ SML : disagreement with SML proposal

Soil parameters	Soil Quality Indicator	Frequency	Depth and scale	Costs (to be included)
Biodiversity	Soil respiration (⊕ SML)	5 y	Topsoil and subsoil /Field	20 to 30 €
	Microbial biomass (⊕ SML)	5 y	Topsoil and subsoil /Field	20 to 30 €
	Enzyme activity (⊕ SML, **optional**)	5 y	Topsoil and subsoil /Field	20 to 80 €
	Microbial communities (Bacteria, Archaea, Fungi, Protists, Animals) (⊕ SML, **optionnal**)	5 y	Topsoil and subsoil /Field	75 to 100 €
	Microfauna (Nematodes) (⊕ SML, **optional)**	5 y	Topsoil and subsoil /Field	30 to 120 €
	Macrofauna (earthworms) (⊕ SML, **optional**)	5 y	Topsoil and subsoil /Field	30 to 140 €
	Mesofauna (⊕ SML, **optional**)	5 y	Topsoil and subsoil /Field	30 to 140 €

EJP SOIL
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⊕ SML : agreement with SML proposal, ∅ SML : disagreement with SML proposal

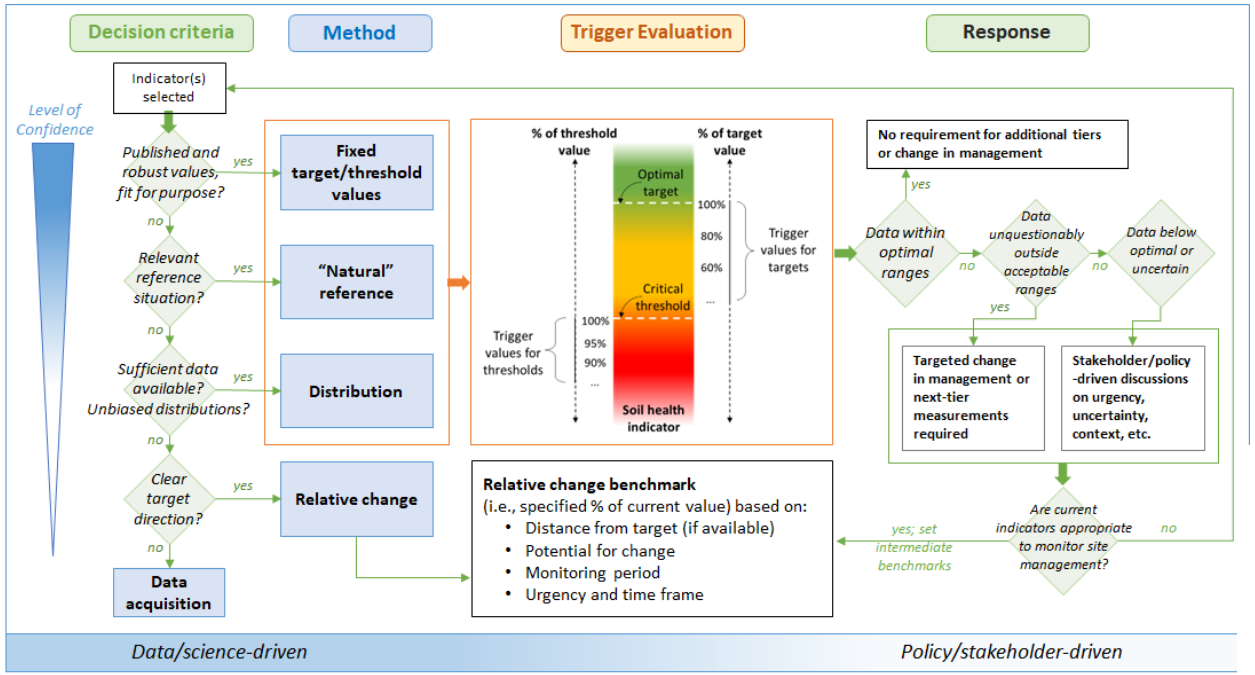
Proposal of a 2-tiered system of biological indicators: tier I

Priority level	Recommended indicators		Brief description	Methodology	Estimated cost/sample (sampling not included)	Sensitivity to degradation processes
Tier I	Functional indicators	Microbial biomass C (⊕ SML)	Amount of microbial biomass per gram soil	ISO 14240-1:1997 ISO 14240-2:1997	20-30€	1. Decline of SOC 2. Desertification 3. Erosion 4. Soil sealing and urbanization 5. Pollution and salinization 6. Compaction
		Microbial respiration (∅ SML)	Production of CO2 per amount of soil	ISO 16072:2002	20-30€	
		Enzyme activity (⊕ SML, **optional**)	Measurement of several hydrolase activities in soil	ISO 20130:2018 ISO/TS 22939:2019	20-80€	
	Structural indicators	Macrofauna (Earthworms) (⊕ SML, **optional**)	Structural and functional diversity	ISO 23611-1:2018	30-140€	
		Mesofauna (⊕ SML, **optional**)	Structural and functional diversity	ISO 23611-2:2006 QBS-ar (Parisi et al., 2005)	75-140€	
		Nematodes (⊕ SML, **optional**)	Structural and functional diversity	ISO 23611-4:2006	30-120€	
		Microbiota (bacteria and fungi) (⊕ SML, **optional**)	Structural diversity of soil microbiota	DNA metabarcoding (ISO 11063:2020) and Plassart et al., 2012	75-100€ (for each target)	

Recommended for SML

⊕ SML : agreement with SML proposal, ∅ SML : disagreement with SML proposal

Setting soil health targets and thresholds for agricultural soils: a framework for their selection and use



Matson et al. under review

The concpets of trigger and target values have been included in the SML rev II text proposal.

Article 7 – Criteria for healthy soil condition

New recital 27a

In order to make a clear distinction between the aspirational long-term objective of the proposal and the operational aspects of implementing sustainable soil management practices, the criteria for healthy soil condition of the soil descriptors are split into non-binding sustainable target values and operational trigger values. The non-binding sustainable target values reflect the long-term aspirational objective of the proposal and do not impose an obligation to act. These target values reflect, based on the current scientific knowledge, the ideal situation where the capacity of soils to provide ecosystem services will not decrease and no significant harm will occur to human health or the environment. However, bearing in mind the need for efficiency and the limited resources available, measures to achieve good soil health need to be prioritized and implemented gradually. Therefore, operational trigger values are needed. These values set in motion appropriate measures to maintain or regenerate soil health. For each aspect of soil degradation, one or several proportional and feasible trigger values are set. This enables a stepwise implementation of measures ranging from vigilance and awareness raising over sustainable management to regeneration practices. Setting the trigger values at Member State level ensures that local conditions and practices and current policies can be fully taken into account.

knowledge harmonization, organization & storage

Double sampling exercise - EJPSOIL support for the validation of transfer functions

Analytical procedures

- Double samples obtained from LUCAS 2022 samplers
- Between 100 and 200 sites will be analyzed depending on the countries
- 17 countries involved
- Comparison of EU and national results

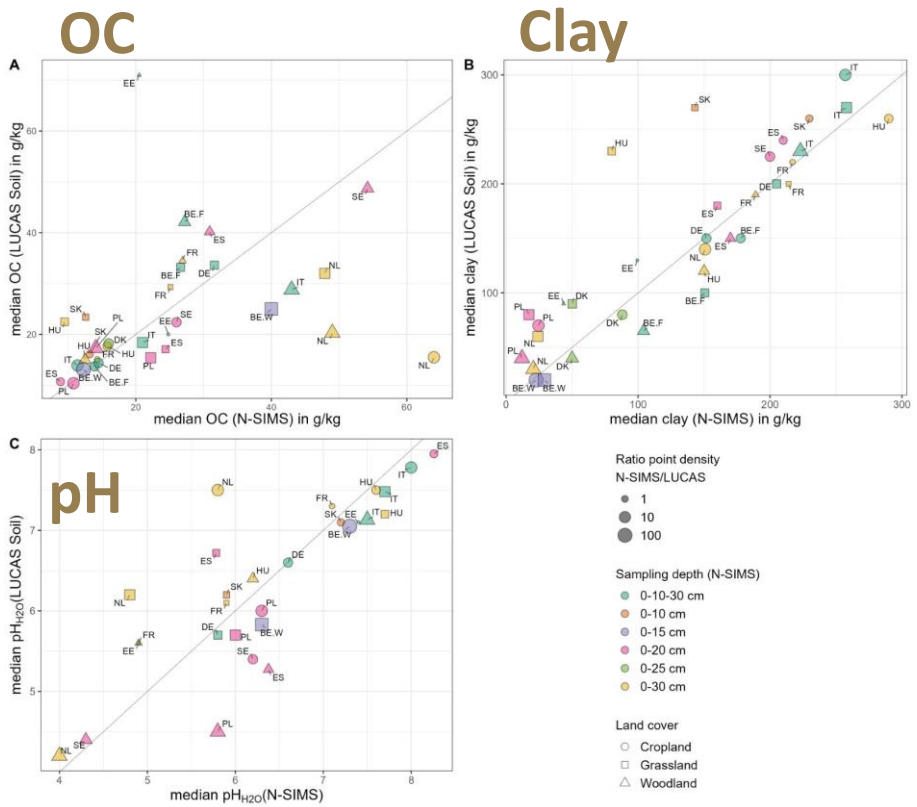
Sampling and analytical procedures

- Sampling (on national SMS and/or on LUCAS 2022 points) according to national and LUCAS sampling protocols
- 6 countries involved
- Compare the overall process

knowledge harmonization, organization & storage

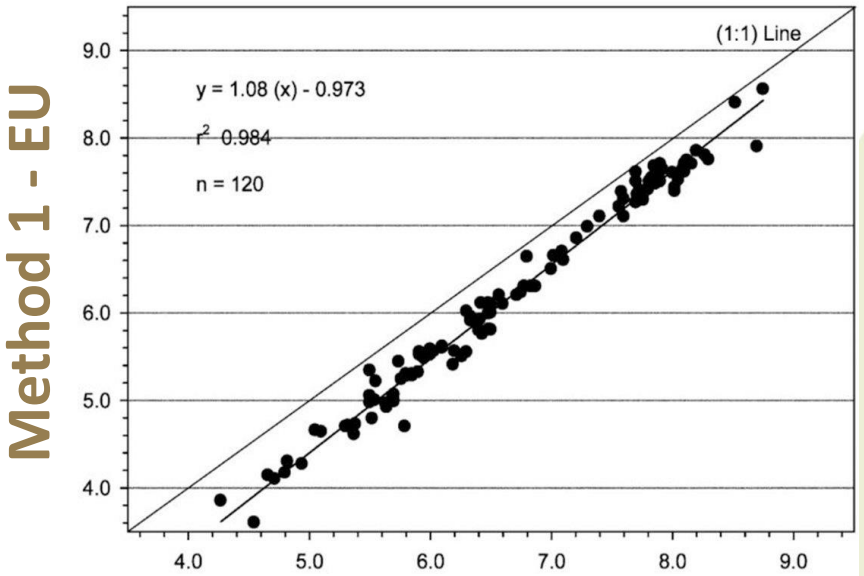
To be done: comparison of LUCAS and national soil datsets and development of transfer/intercomparison methods based on samples collected during LUCAS 2022 campaign

LUCAS dataset



National datasets

- **Double sampling exercise done during LUCAS sampling in 2022**
  - LUCAS samples collected will be analysed by EU and by national labs
  - Comparison of results will allow to develop transfer functions



Update of the double sampling exercise – Samples obtained/prepared

Status end of February 2024

Country	Involved	Expected	Received	%received	Preparation	Analysis	Expected results
Austria	yes	718	718	100	Finished	Running	Spring 2024
Belgium, Flanders region	yes	166	150	90	Finished	Finished	**Available**
Belgium, Wallonia region	yes	100	69	69	Finished	Running	?
Czech Republic	yes	1207	1207	100	Finished	Finished	**Available**
Denmark	yes	150	150	100	Finished	Running	?
Estonia	yes	78	78	100	Finished	Finished	**Available**
Finland	yes	127	127	100	Finished	Running	Spring 2024
France	yes	200	70	35	Finished	Running	Spring 2024
Germany	yes	100	100	100	Finished	Completed	**Available**
Hungary	yes	107	107	100	Finished	Finished	Spring 2024
Italy	yes	138	138	100	Finished	58 Completed; 81 completed for biological analyses only	**Available**
Norway	no						
Portugal	yes	90	83	92	Finished	Running	February 2024
Slovakia	yes	10	6	60	Running	Running	May 2024
Spain	yes	121	121	100	Finished	Finished	June 2024
Sweden	yes	150	150	100	Finished	Running	March 2024
The Netherlands	yes	300	300	100	Running	Starting	Spring 2024

In June at the latest we wil have all data from MS

Workflow, joint LUCAS and national Soil Information and Monitoring Systems (SIMS) to achieve the common maps

WP6
Task 6.3

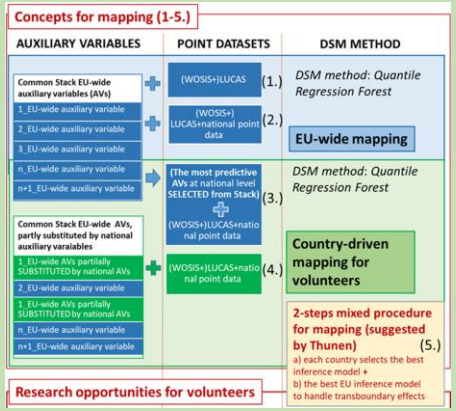
Comparison of soil property data, available in both **LUCAS and SIMS** datasets based on common R-scripts (by INRAE):

- identification
- data conversion
- explanatory analysis
- spatial analysis, maps

Accep table result

WP6
Task 6.2

„preliminary concept”



EU-wide common auxiliary variable set and shared platform and guidance for mapping

refresh

FUTURE

WP6
Task 6.3

Initialized LUCAS double sampling campaign to measure the same sample of soil parameters according to LUCAS and national methodologies

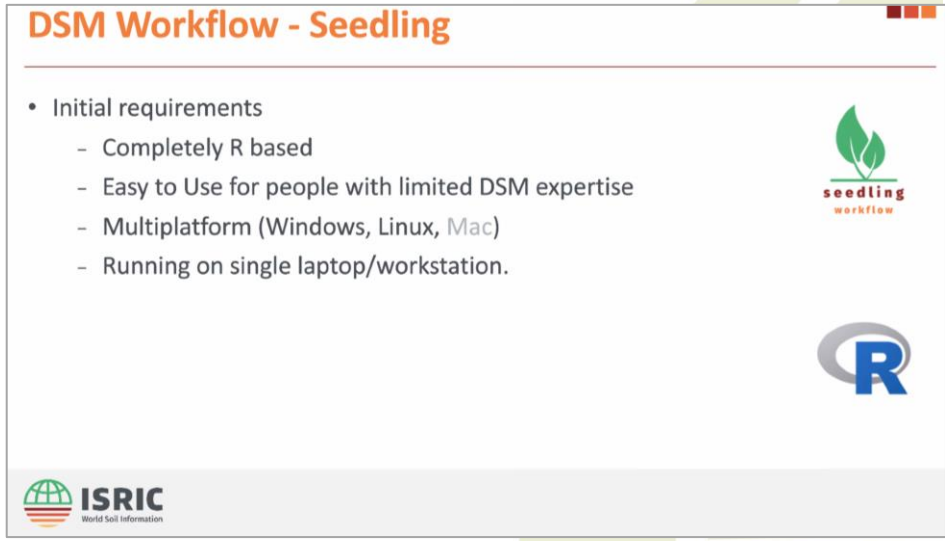
Expected results are (?after EJP): transfer functions

EJP SOIL
European Joint Programme

Main outcomes of the meetings and activities (2022 3.Q -2023)

- The set of the **100 m, EU-wide** auxiliary variables was produced by ISRIC, but it was very computationally intensive for Europe (approx. 3 GB per covariate; it took time;)
- **Sources**: MERIT DEM, Sentinel, Landsat, Copernicus
- Seasonality (green maxima) is difficult to calculate due to cloud cover in northern areas
- **226 EU-wide auxiliary variables**, representing the soil forming processes, in 100 m resolution are **ready to use** for mapping
- Participant countries have to convert national data (e.g. geology) to continental grid
- Added value is to use also national data for EU maps

- We need to **renew** the preliminary concept of mapping
- **A DSM workflow platform shared** by ISRIC is **ready to support national mapping**



Genova, G., Poggio, L., Kempen, B., & Colman, B. (2024). DSM Workflow Seedling. ISRIC - World Soil Information. https://doi.org/10.17027/ISRIC-FSX2-2691

The common stack of EU-auxiliary variables

SOURCE	DERIVED
MERIT DEM a high accuracy global DEM at 3 arc second resolution. https://doi.org/10.1002/2017GL072874	Elevation; Slope; Aspect; LandForms; CHILI; TopoDiversity; MTPI; Flow accumulation; Curvature
EU Copernicus DEM, 25m resolution with vertical accuracy: +/- 7 meters RMSE. https://land.copernicus.eu/imagery-in-situ/eu-dem/eu-dem-v1.1	Elevation; Slope; Topographic wetness index; Multi-resolution Valley Bottom Flatness (MRVBF) index; geomorphon
ERA5 is the fifth generation ECMWF atmospheric reanalysis of the global climate. https://cds.climate.copernicus.eu/cdsapp#!/home	ERA5 DAILY provides aggregated values for each day for: Temperature (2m); Total precipitation; Runoff; Total evaporation; Surface net solar radiation
Global Precipitation Measurement (GPM). 10.5067/GPM/IMERG/3B-MONTH/06	is an international satellite mission to provide next-generation observations of rain and snow worldwide every three hours.
Sentinel 2	Bands calculated: Reflectance bands; Some common indices: NDVI,NDWI, NDSI, NBR2, NDDI; LAI; fapar
Landsat (7,8,9)	Bands calculated: Reflectance bands; Some common indices: NDVI,NDWI, NDSI, NBR2, NDDI; tasseled cap (Brightness, Greenness, wetness); Thermal bands
MODIS, Evapotranspiration/Latent Heat Flux product is an 8-day composite product produced at 500 meter pixel resolution.	Bands calculated: ET; PET; Gpp; PsnNet
Sentinel1	Bands calculated: VV; HH
Copernicus Global Land Cover Layers	100 m land cover map annual updates to the 100m global land cover maps, covering the 2015-2019 period, including the same 23-class classification

T6.2 **Renewed** concept and main focuses in 2024 (3. and 4.)

	POINT DATA	COVARIATES	DSM method	APROACH	CONDITIONS & RESEARCH QUESTIONS
1	~~WOSIS~~+LUCAS 2009	**100m covariates stack (ISRIC)**	**ISRIC script for covariates selection and Quantile Regression Forest**	EU-wide	This is a **top-down approach** as base for comparison. ISRIC
2	~~WOSIS~~+LUCAS2009+**national points**	**100m covariates stack (ISRIC)**	**ISRIC script for covariates selection and Quantile Regression Forest**	EU-wide	Does the adding of national points increase the accuracy? The voluteering **countries will share their point data, if necessary, to solve transboundary issues**.
3	~~WOSIS~~+LUCAS2009+national points (**each country separate**)	100m covariates stack (ISRIC)	**ISRIC script for covariates selection and Quantile Regression Forest**	Country driven	This is a **country driven approach** (which avoid soil point data sharing) but using only common EU-wide covariates. partners
4	~~WOSIS~~+LUCAS2009+national points (**each country separate**)	100m covariates stack (ISRIC) **+ substituted by national covariates**	**ISRIC script for covariates selection and Quantile Regression Forest**	Country driven	Does the use of national covariates improve the accuracy, and what is the transboudary effect? partners
5	2-step procedure: a) best national point data (each country decide it, to include or not also WOSIS +LUCAS) b) WOSIS+ LUCAS	2-step procedure: a) each country selects the best covariates b) the maps produced at step a) will be used as predictors (merged) + the most predictive EU-wide auxiliary variable selected with approach 1 (with respect to pH in water, first)	2-step procedure: a) each country selects the best inference model b) the best EU inference model	mixed	**Proposal from THUNEN** It would constitute a way **to merge country-driven soil maps** Does the method get to smoothy the trensboundary effects, and what is the effect on accuracy?

Concepts 3-4. are bottom-up approaches. It can be done with volunteers, 5 countries have so far indicated their participation (Netherlands, Italy, Hungary, Germany and France)

Germany: earlier they offered their contribution in the concept-5., which would be a mixed method for finally an EU-wide mapping product.

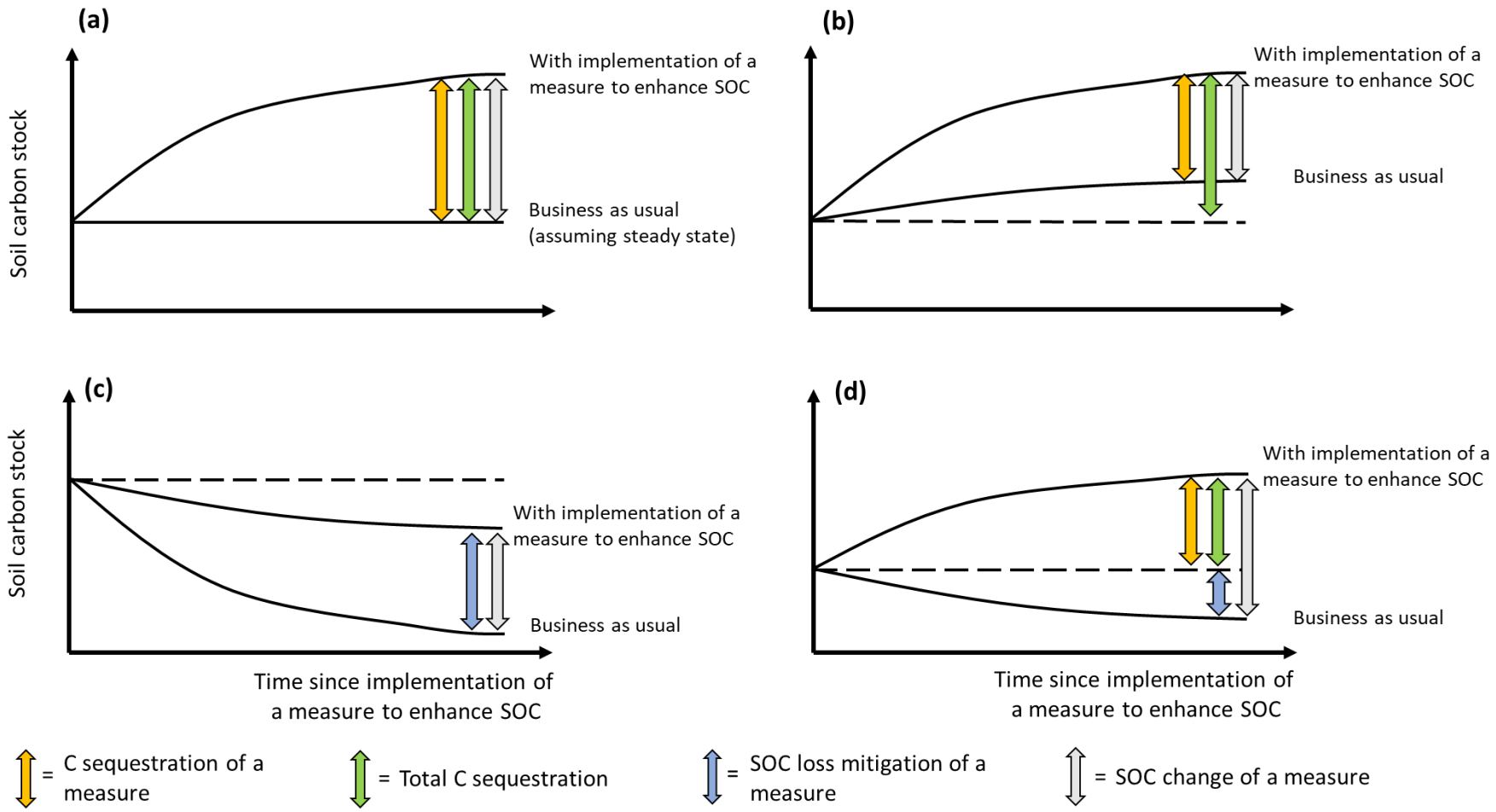
WP3 - Knowledge development
ALCUNI DEI RISULTATI DEI PROGETTI INTERNI DI RICERCA

Sustainable soil management
Climate change mitigation
Climate change adaptation
Assessing and monitoring soils
Fostering adoption of sustainable soil management practices

EJP SOIL
European Joint Programme

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652615.

Carbon sequestration in soils and climate change mitigation – Definitions and pitfalls

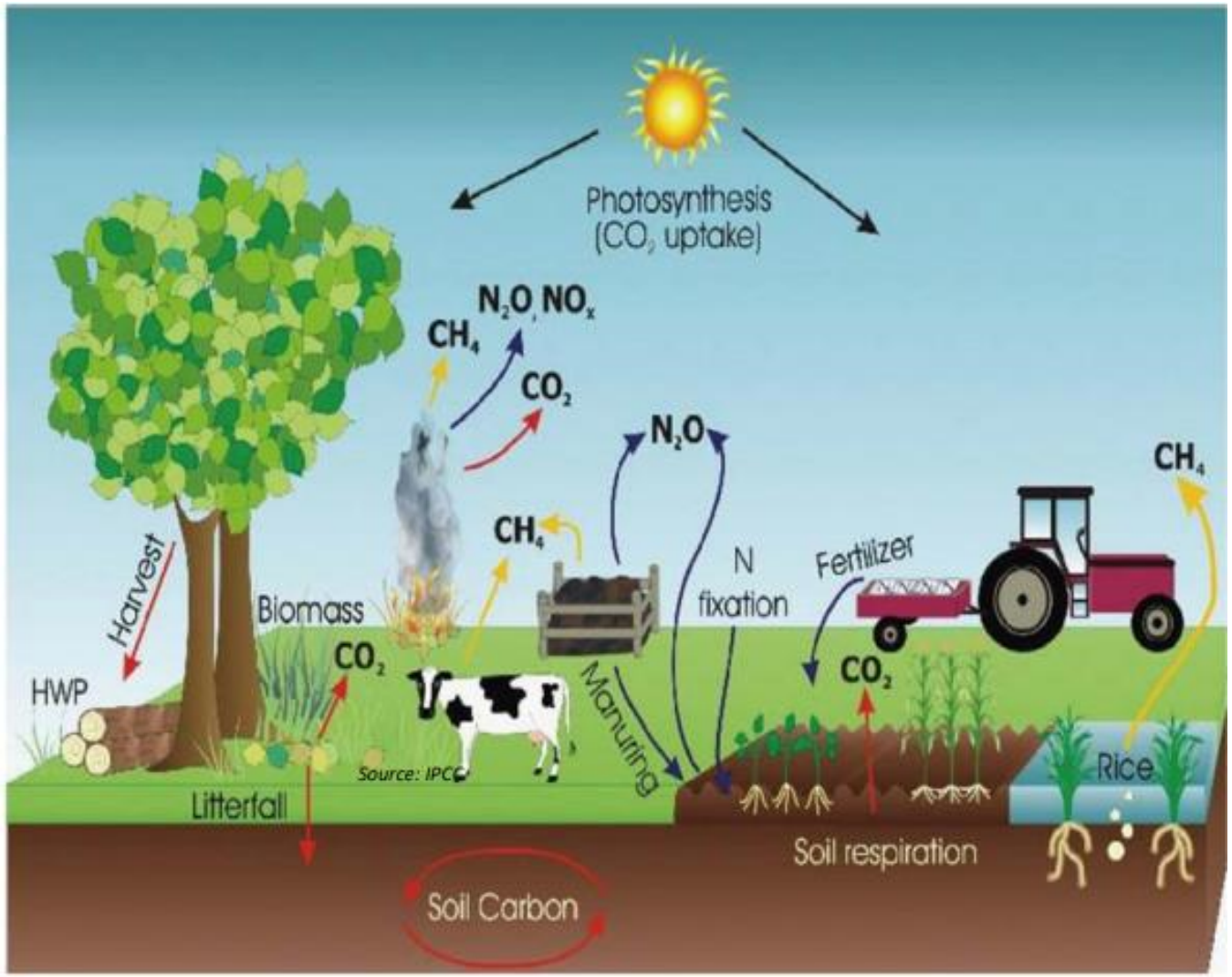


Il contenuto di SOC dello scenario Business as Usual (= nessuna misura di carbon farming adottata) varierà in base al clima futuro. Dunque, l'effetto delle misure di carbon farming potrà non essere visibile in termini di sequestro effettivo di SOC nel suolo, ma solo in termini di mitigazione delle perdite di SOC.

Don et al. 2023 Global Change Biology, DOI: 10.1111/gcb.16983

Coordination for Italy Farina CREA
roberta.farina@crea.gov.it

Trade-offs and synergies of soil carbon sequestration –



The SOMMIT project will evaluate trade-offs and synergies between soil C sequestration, nitrous oxide, methane and nitrate losses as affected by soil management options aimed at increasing soil C storage.

https://ejpsoil.eu/soil-research/ommit

Coordination Lagomarsino CREA
alessandra.lagomarsino@crea.gov.it

Trade-offs and synergies of soil carbon sequestration – Review of knowledge (gaps)

Soil management strategy	SOC change	N_2O emission mitigation	CH_4 emission mitigation	N leaching
Tillage management		?	?	?
Cropping systems	ROT; LEG; ORG; CONS	CONS; CC; CC incorpor-ated into the soil; CG; CF / CONS; ORG; PER	ORG; AGF; CG; CF	CC; LEG; ORG
Water Management			?	
Fertilization and OM input – *Crop residues*			N/A	
Fertilization and OM input – *Cover crops*			N/A	
Fertilization and OM input – *Livestock manure, slurry and compost*		?	N/A	N/A
Fertilization and OM input – *Biochar*				
Fertilization and OM input – *Liming*			N/A	

Table legend

N/A: Not Assessed; **no-tillage** (zero-till); **non-inversion tillage** (minimum/ reduced tillage); legume non-legume

Impact: Positive (green color), negative (red color), no difference (grey color)

positive	negative	neutral

Soil managment strategies: 4 categories

Tillage Management	Cropping Systems	Water Management	Fertilization and OM inputs
-Inversion tillage -Non-inversion tillage -No tillage	-Monoculture -Crop rotation -Intercropping -Permanent crop -Agroforestry ➢ Alley cropping ➢ Hedgerows / Shelterbelts ➢ Silvopasture	-No irrigation -Drip irrigation -Flood/Furrow irrigation -Sprinkler irrigation ➢ Center pivot irrigation ➢ Lateral move irrigation ➢ Solid-set sprinkler irrigation ➢ Hand move sprinkler irrigation ➢ Traveling gun sprinkler irrigation	-Crop residues -Cover crop (Green manure / Mulch) -Livestock manure -Slurry -Compost -Biochar -Liming -Digestate -Sludge

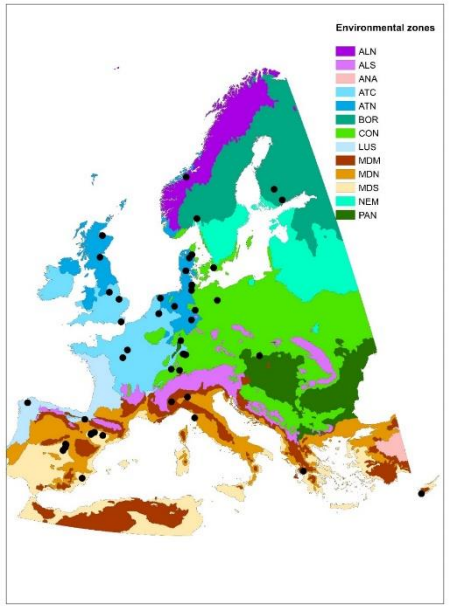
Knowledge gaps and research recommendations

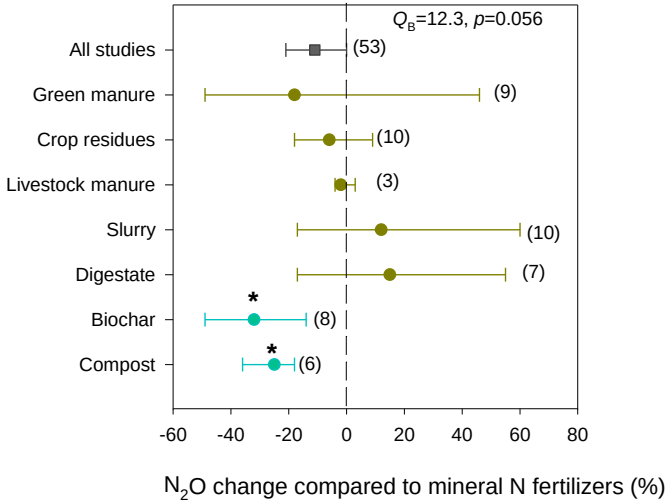
- Effect of soil management strategies on C-sequestration AND N_2O emissions AND CH_4 emissions AND N-leaching
- Interaction effects of soil management strategies
- Pedo-climatic conditions
- Long term effects

Maenhout et al. (2024) Submitted to EJSS

Coordination Lagomarsino CREA
alessandra.lagomarsino@crea.gov.it

N_2O emissions changes due to organic matter (OM) inputs - A meta-analysis





- Over 50 field studies in 15 European countries
- The effects of seven OM types applied either along or in combination with mineral N fertilizer were studied.
- Comparison with mineral N fertilizer

Overall Effect:

A slight tendency to reduce N_2O emissions by 10%

Compost and Biochar :

- Mitigated N_2O by 25 % and 33%, respectively.
- Mitigation depends
  - ✓on climate
  - ✓soil properties (pH and sand)

Other OM:

- No effect compared to mineral N
- Application strategy important:

✓ -16% (OM alone)

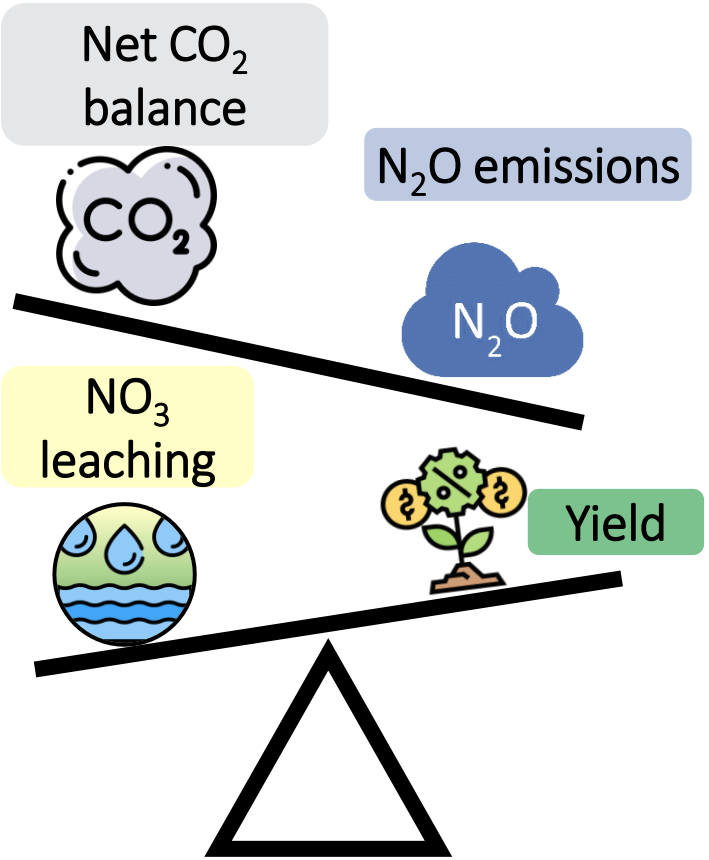
✓+ 14% (OM+ Mineral N)

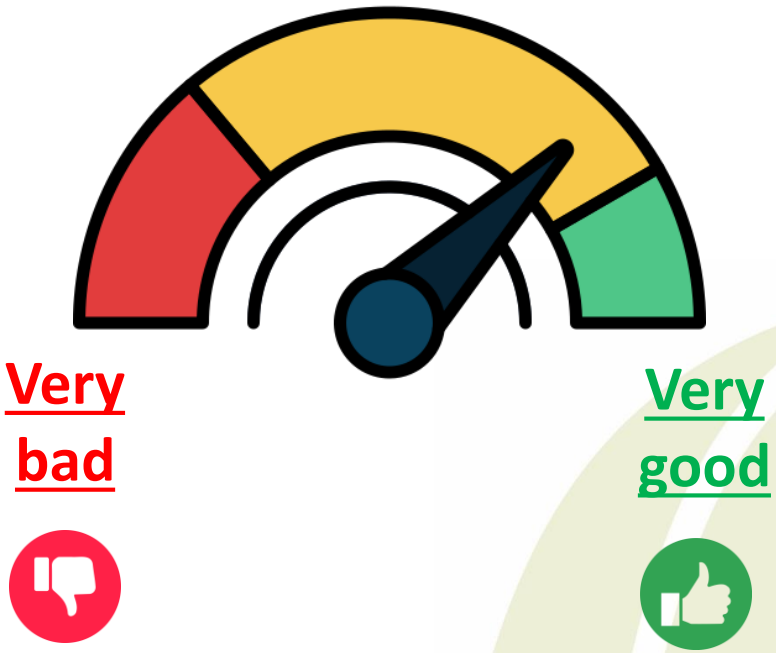
Trade-off

Valkama et al. (2024) Submitted to EJSS

Coordination Lagomarsino CREA
alessandra.lagomarsino@crea.gov.it

Trade-off assessment system and the ∑ommit index

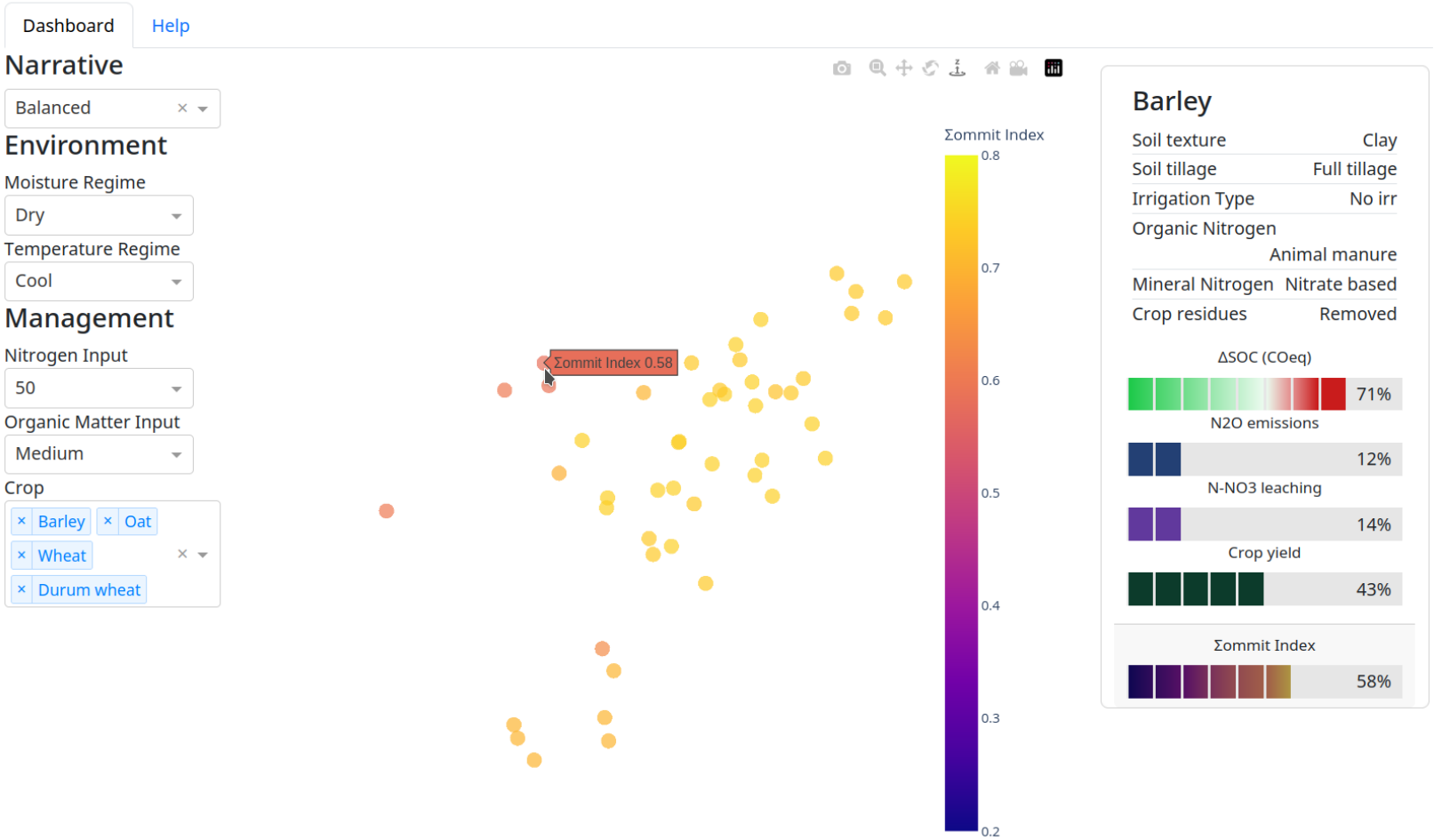




2 milions agronomic case- scenarios → **4 trade-off components** → **∑ommit index**

Calone et al. (2024) https://doi.org/10.1016/j.jclepro.2024.140878

Σommit Trade-offs analysis

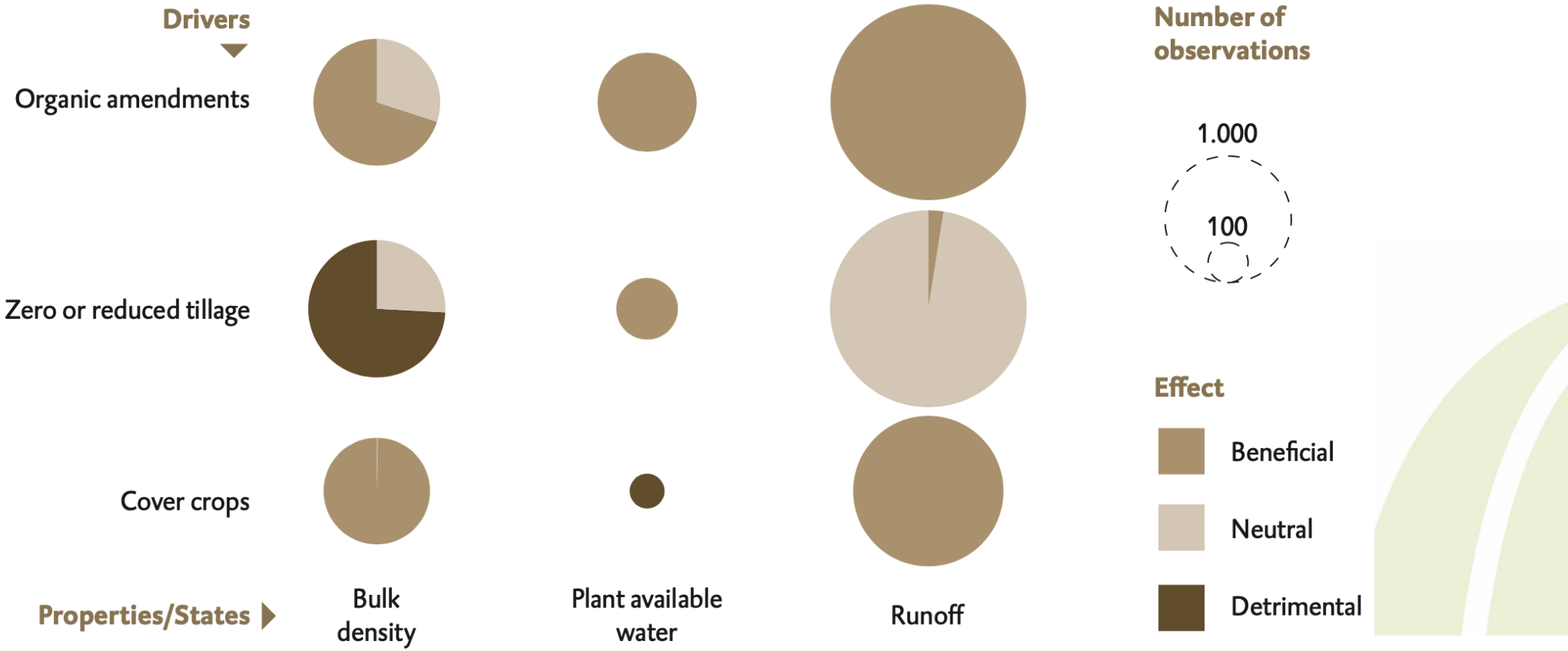


online tool https://github.com/kofm/sommit-dashboard

Soil and crop management practices and the water regulation functions of soils: a qualitative synthesis of meta-analyses relevant to European agriculture

Scientific evidence on three practices

163 meta-analyses
2803 primary studies



S. Garré et al. 2021-Climasoma report
G. Blanchy et al. 2023- Soil
Link to policy brief

Coordination for Italy Di Bene CREA
claudia.dibene@crea.gov.it

Soil and crop management practices and the water regulation functions of soils: a qualitative synthesis of meta-analyses relevant to European agriculture

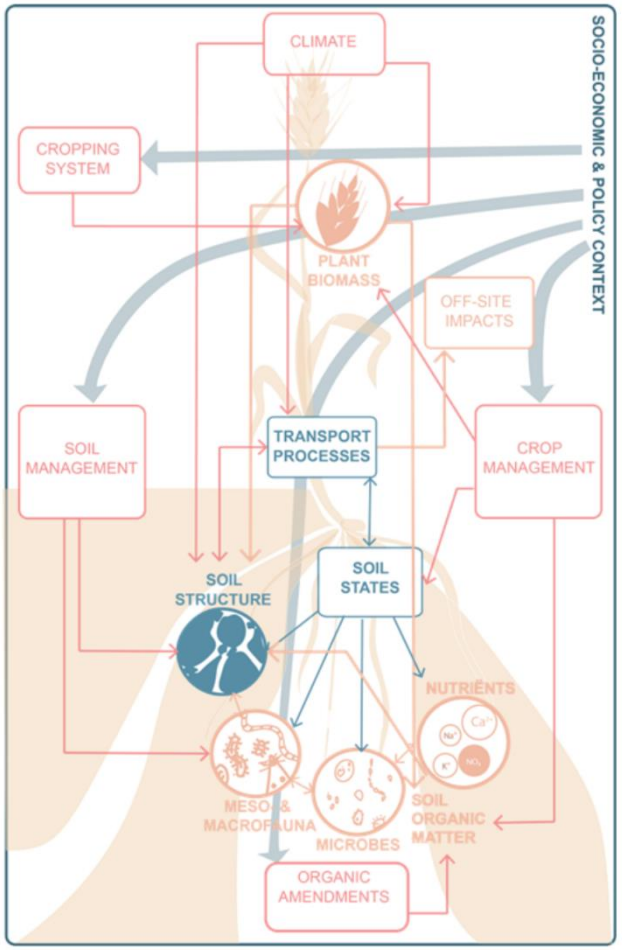


Figure 1. Schematic diagram of drivers, agents and processes governing the dynamics of soil structure and its effects on the soil–plant system.

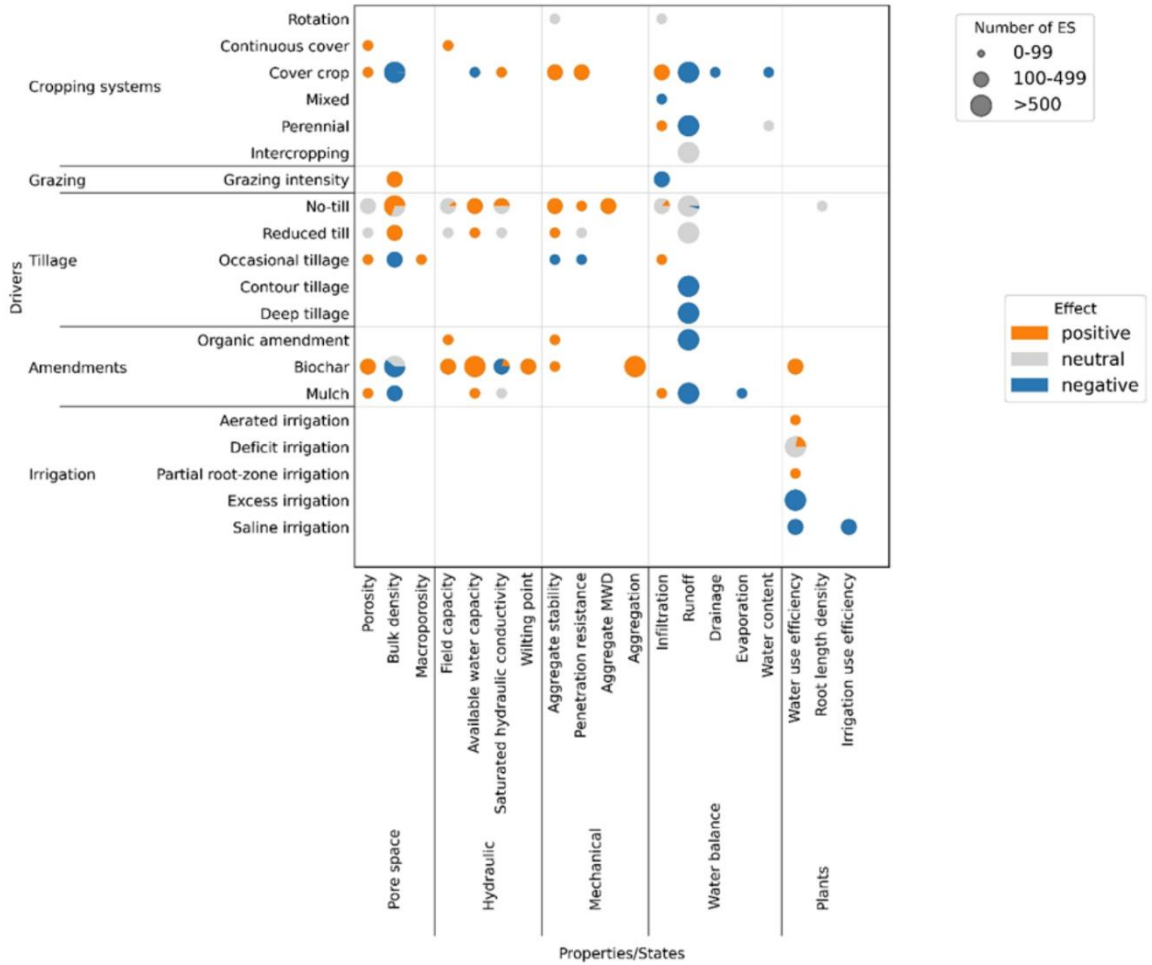
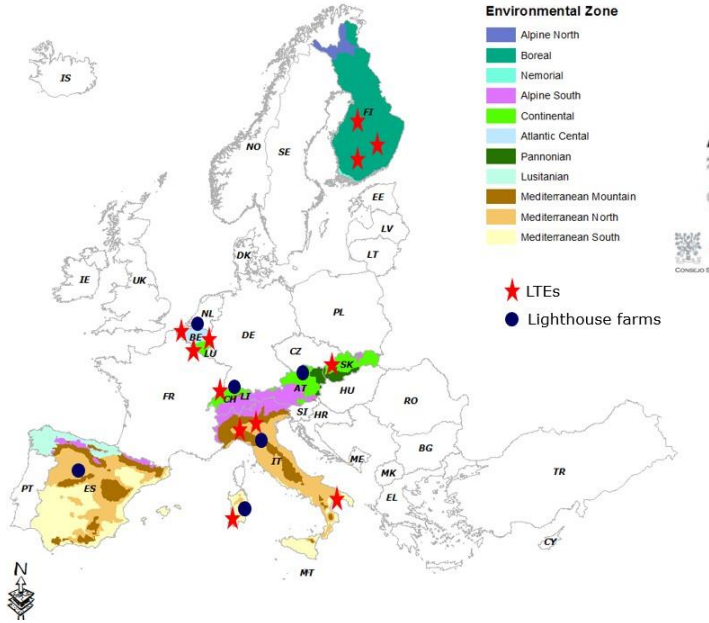


Figure 5. Effects of drivers (vertical axis) on target variables (horizontal axis) in the 36 selected meta-analyses. The colored pie charts represent the directions of the statistical effects in the different meta-analyses, while the size of the circle indicates the total number of effect sizes (ESs) reported. Note that this number has not been corrected for redundancy. Blank cells denote that no data were available for this target variable in any of the selected meta-analyses.

Blanchy et al. 2023 https://doi.org/10.5194/soil-9-1-2023

AgRo-ecological strategies for promoting climaTE change MItigation and adaptation by enhancing Soil ecosystem services and sustainable crop production



Living labs cerealicoli in agricoltura conservativa in Italia sono gestiti da ERSAF e AGRIS

LTE del CREA - Mitorg a Metaponto focalizzato sull'orticoltura di pieno campo in biologico

Coordination for Italy Di Bene CREA
claudia.dibene@crea.gov.it

- Long-term data
- Soil-crop modelling (Process-based model **ARMOSA**)
- Literature review
- Meta-analysis
- Direct exchange with practitioners (participatory action research approach)

LTE + LIVING LAB
+ MODELING
+ META-ANALYSIS

Upscaling the **agro-ecological transition** based on **Living labs** composed by real farms around the field research and stakeholders' community.

Alcuni risultati preliminari di ARTEMIS, simulazioni con ARMOSA di variazione di SOC in suoli agricoli della Finlandia

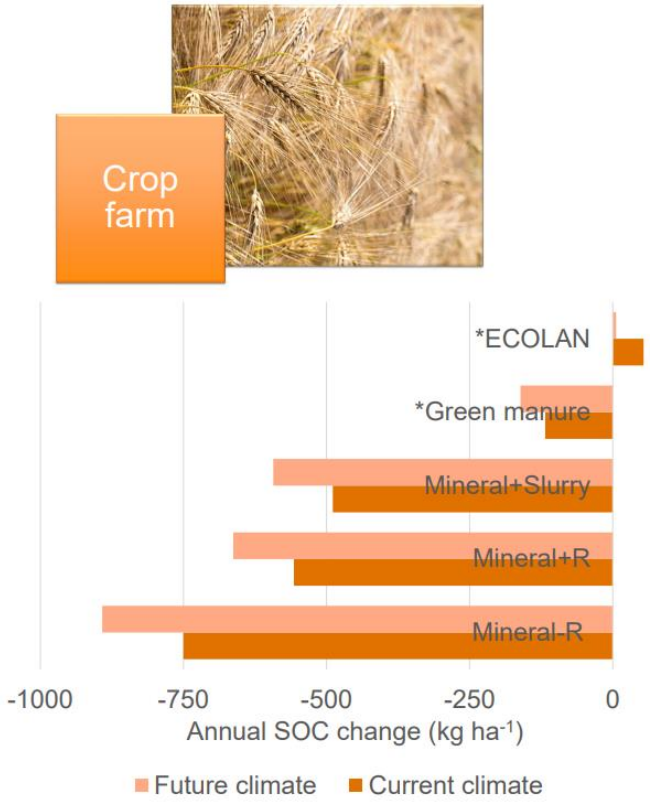


Figure 1. Annual SOC change in crop production farms for current climate and future climate scenario. Crop residues removed (–R) or retained (+R). ECOLAN: meat and bone meal-based commercial organic fertilizer. Organic farming marked by *

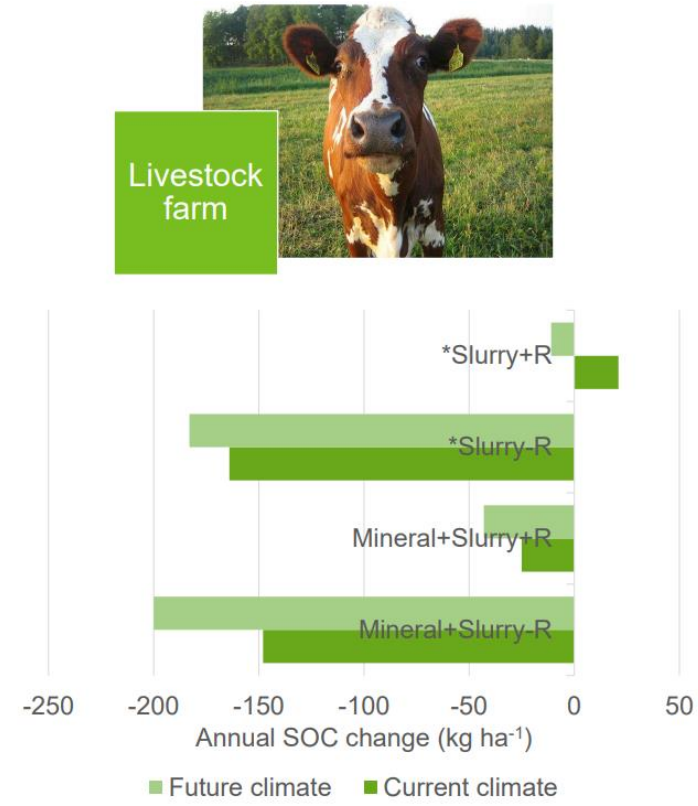


Figure 2. Annual SOC change in livestock production farms for current climate and future climate scenario. Crop residues removed (–R) or retained (+R). Organic farming marked by *

METHOD

- Process-based model ARMOSA
- For both current (1999-2018) and near future climate scenarios (2020-2040, RCP 6.0)

MODEL INPUTS

- Daily meteorological data from Mikkeli station
- Statistical data in the region during the last 20 years

CONCLUSION

Climate change will challenge C storage in agricultural soil, and organic farming may provide a means for tackling this problem.

Autori: Elena Valkama (LUKE), Alessia Perego and Marco Acutis (UNIMI)

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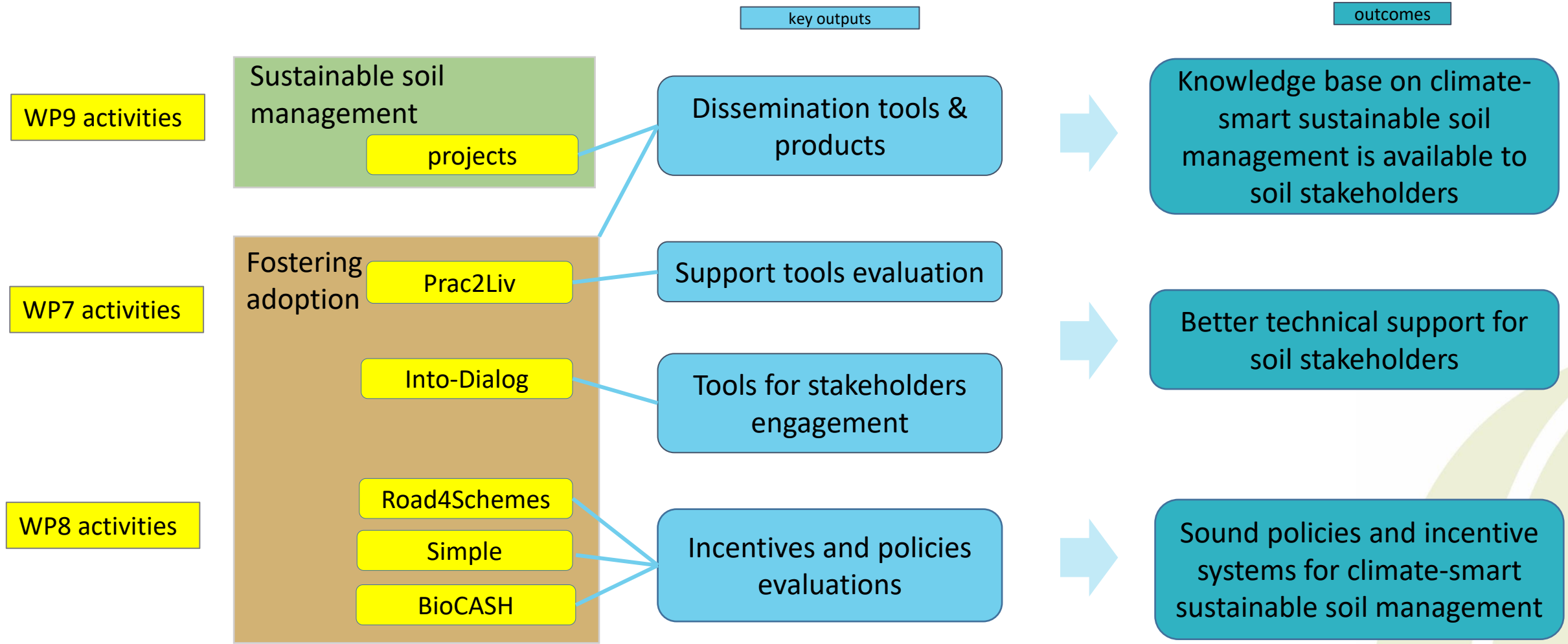
Coordination for Italy Di Bene CREA
claudia.dibene@crea.gov.it

EJP SOIL EI5: Fostering the uptake of soil management practices which are conducive to climate change adaptation and mitigation



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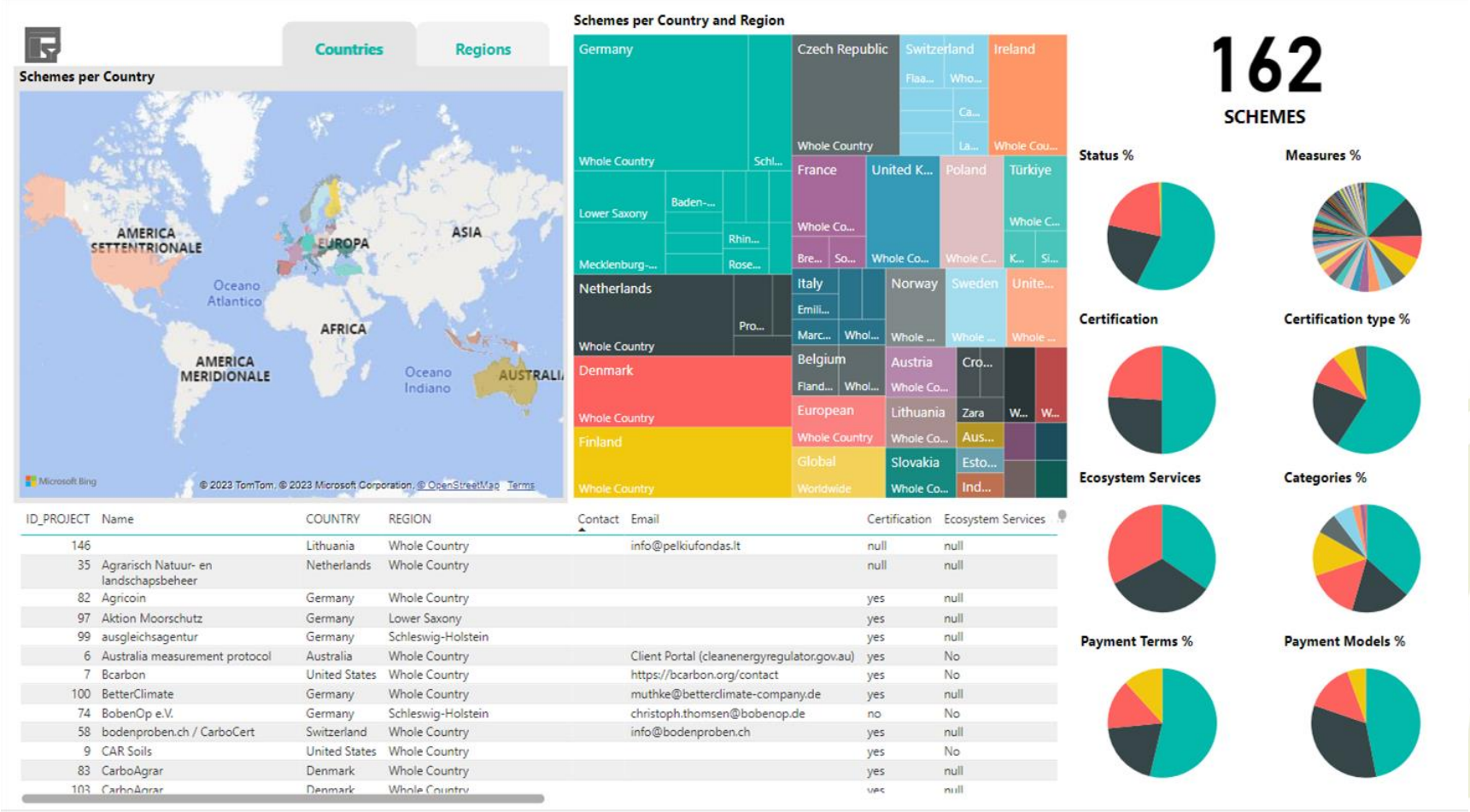
An analysis of existing carbon farming schemes

CARBON FARMING

Carbon farming means taking actions that lead to an increase of the carbon content of the soil or to a decrease in carbon emissions, e.g. caused by oxidation, additional to standard soil management.

Scheme

A scheme is any voluntary agreement in which a farmer or a group of farmers commit themselves to apply carbon farming measures in return for a payment in any form.



ID_PROJECT	Name	COUNTRY	REGION	Contact	Email	Certification	Ecosystem Services
146		Lithuania	Whole Country		info@pelkiufondas.lt	null	null
35	Agrarisch Natuur- en landschapsbeheer	Netherlands	Whole Country			null	null
82	Agricoin	Germany	Whole Country			yes	null
97	Aktion Moorschutz	Germany	Lower Saxony			yes	null
99	ausgleichsagentur	Germany	Schleswig-Holstein			yes	null
6	Australia measurement protocol	Australia	Whole Country		Client Portal (cleanenergyregulator.gov.au)	yes	No
7	Bcarbon	United States	Whole Country		https://bcarbon.org/contact	yes	No
100	BetterClimate	Germany	Whole Country		muthke@betterclimate-company.de	yes	null
74	BobenOp e.V.	Germany	Schleswig-Holstein		christoph.thomsen@bobenop.de	no	No
58	bodenproben.ch / CarboCert	Switzerland	Whole Country		info@bodenproben.ch	yes	null
9	CAR Soils	United States	Whole Country			yes	No
83	CarboAgrar	Denmark	Whole Country			yes	null
103	CarboAgrar	Denmark	Whole Country			yes	null

https://ejpsoil.eu/science-to-policy
http://reports.crea.gov.it/powerbi/CarbonSchemesInventory.html

Coordination for Italy Martelli CREA
andrea.martelli@crea.gov.it

Knowledge sharing and transfer

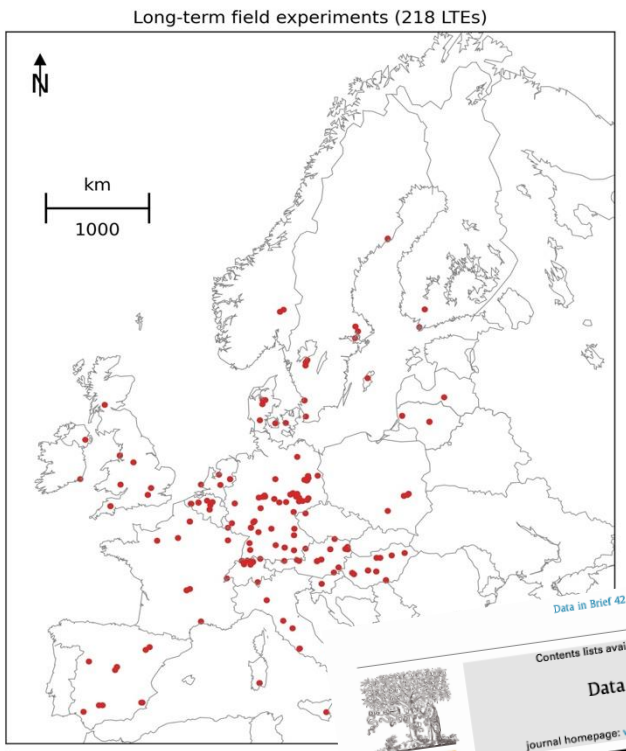
EJP SOIL
European Joint Programme

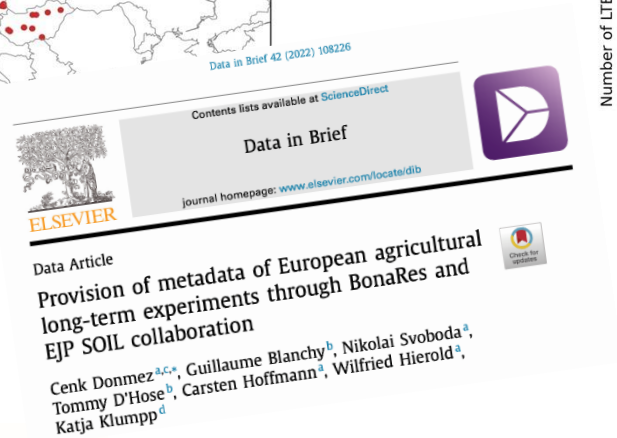
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652615.

knowledge development

knowledge sharing &transfer

Research infrastructures: Long Term Experiments




Data in Brief 42 (2022) 108226

Contents lists available at ScienceDirect

Data in Brief

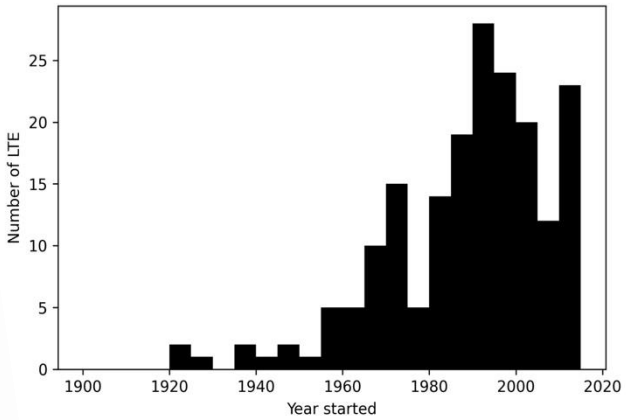
journal homepage: www.elsevier.com/locate/dib

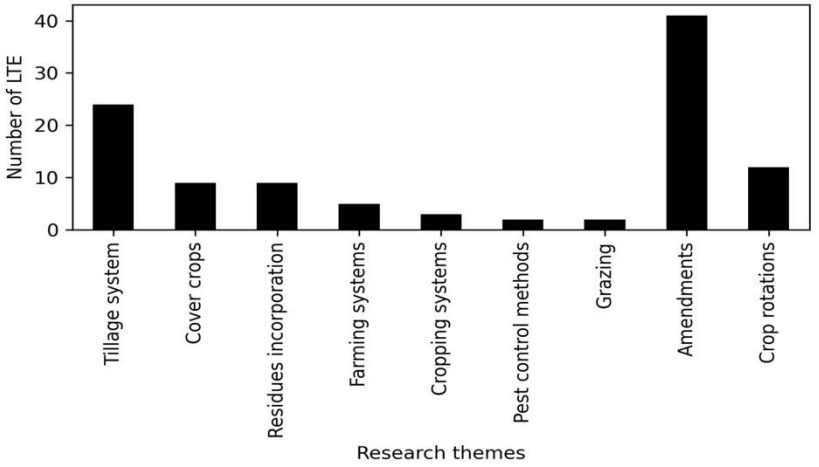
ELSEVIER

Data Article

Provision of metadata of European agricultural long-term experiments through BonaRes and EJP SOIL collaboration

Cenk Donmez[a,c,*], Guillaume Blanchy[b], Nikolai Svoboda[a], Tommy D'Hose[b], Carsten Hoffmann[a], Wilfried Hierold[a], Katja Klumpp[d]





https://lte-eu.bonares.de/experiments

Dommez et al. 2022, Data in Brief

EJP SOIL
European Joint Programme

knowledge development

knowledge sharing &transfer

An open-source metadataset of running European mid- and long-term agricultural field experiments

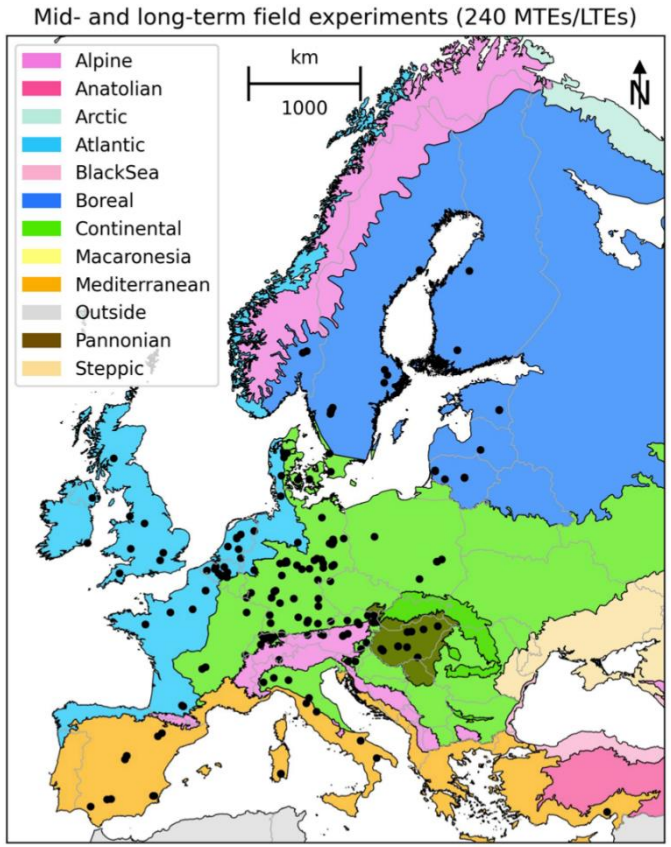


FIGURE 3 Distribution of the collected mid- and long-term field experiments across Europe with European biogeographical regions.

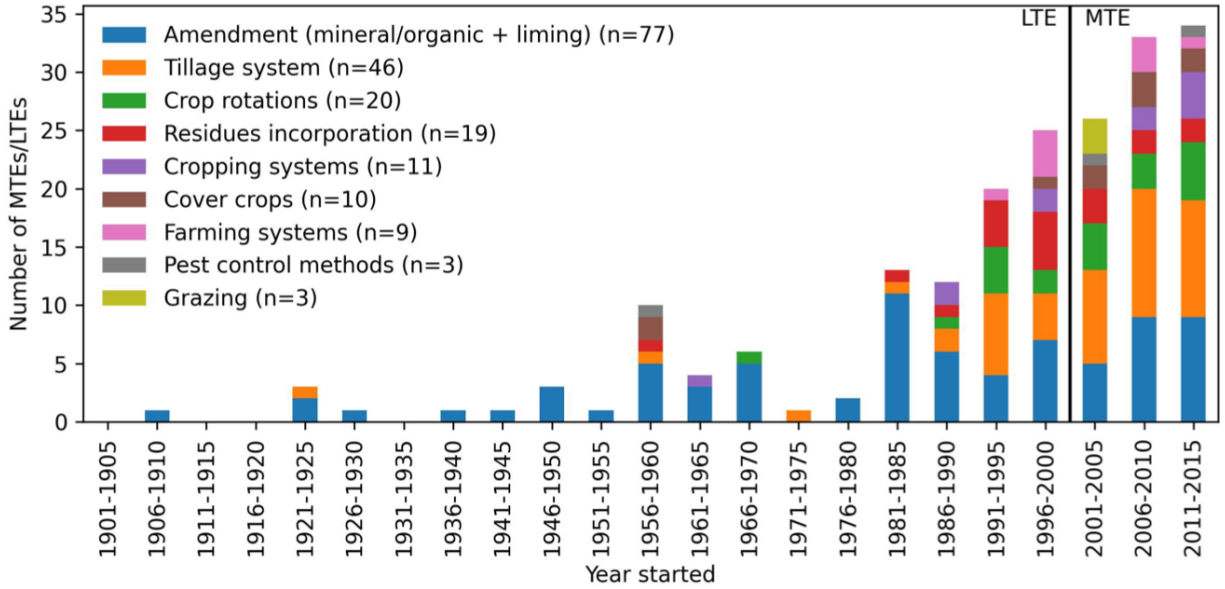


FIGURE 6 Evolution of newly started MTEs/LTEs with respect to their research themes. Note that one MTE/LTE can have several research themes (e.g. it can investigate both tillage and cover crops) and hence can be counted multiple times. The research theme about 'amendments' includes experiments that investigate mineral/organic or no fertilizer (67 MTEs/LTEs) and 10 MTEs/LTEs investigating liming.

Dommez et al. 2023, Soil Use and Management
DOI: 10.1111/sum.12978
https://lte-eu.bonares.de/experiments

EJP SOIL
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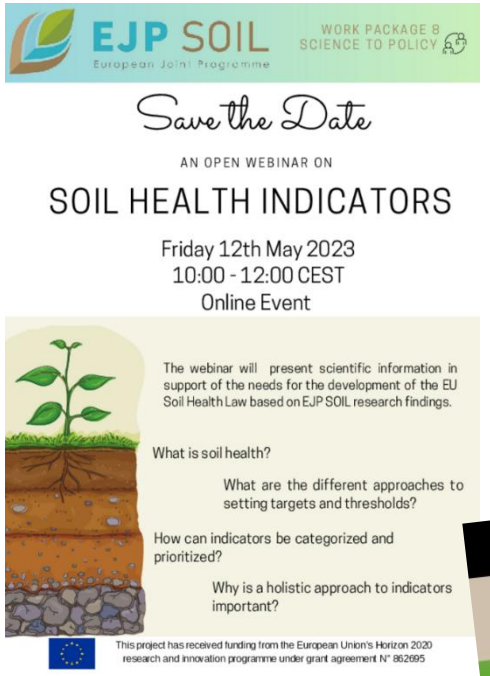
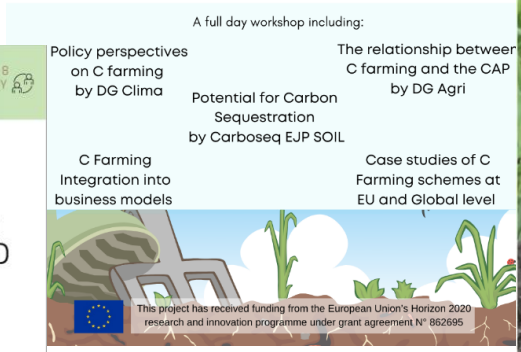
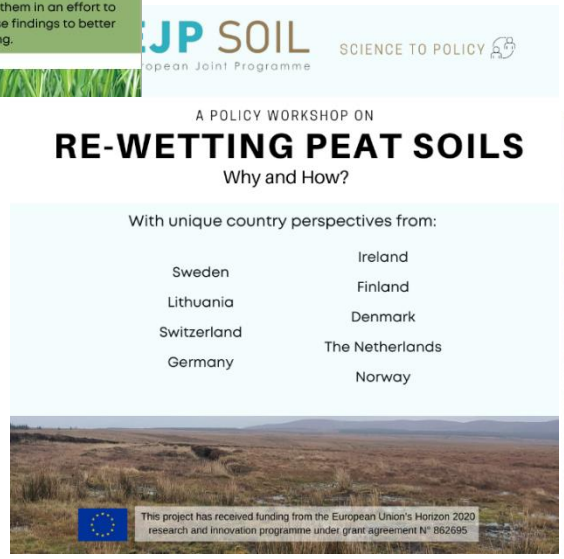
https://ejpsoil.eu/knowledge-sharing-platform/webinar-recordings







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