# Soil Health Monitoring

## How do you generate and share meaningful data?

25/06/2025

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Keep your mic muted

Change your name and add your organisation

Type your question(s) in the chat

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# Let's interact!

# How to measure Soil Health

**Maurits Voogt**

Director of External Affairs

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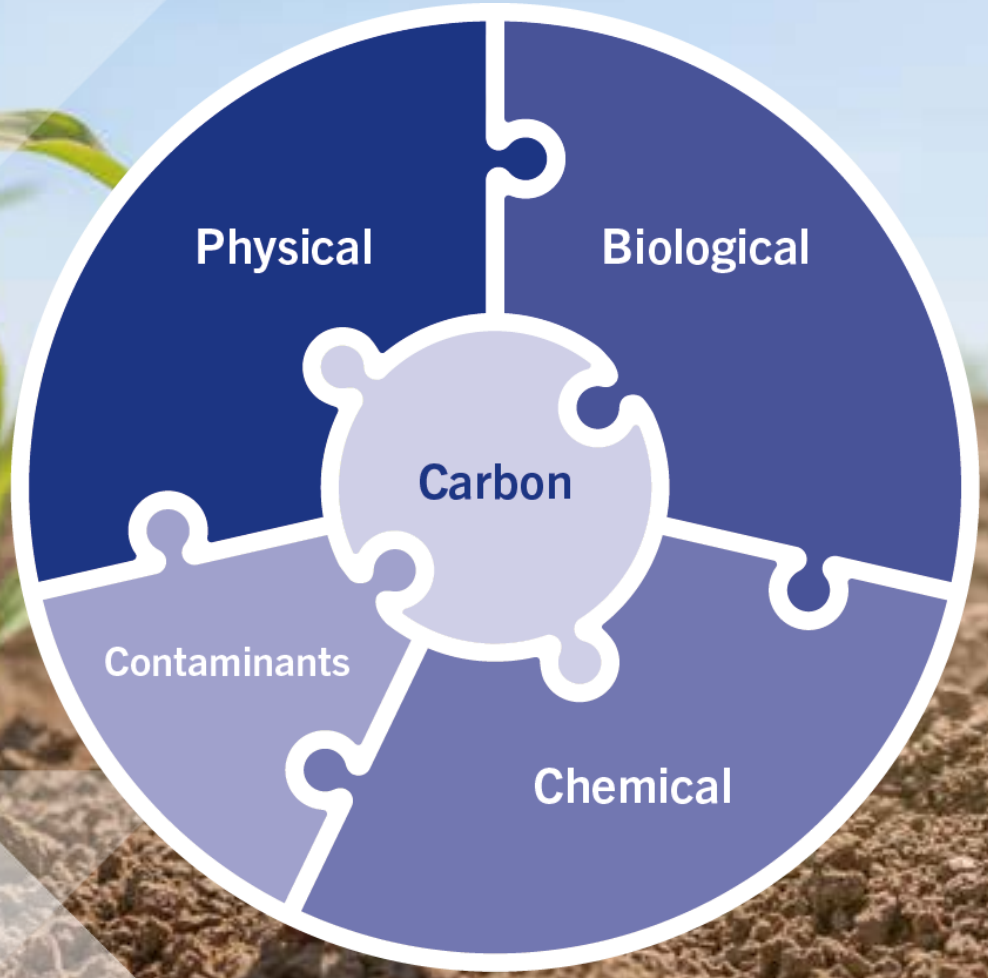
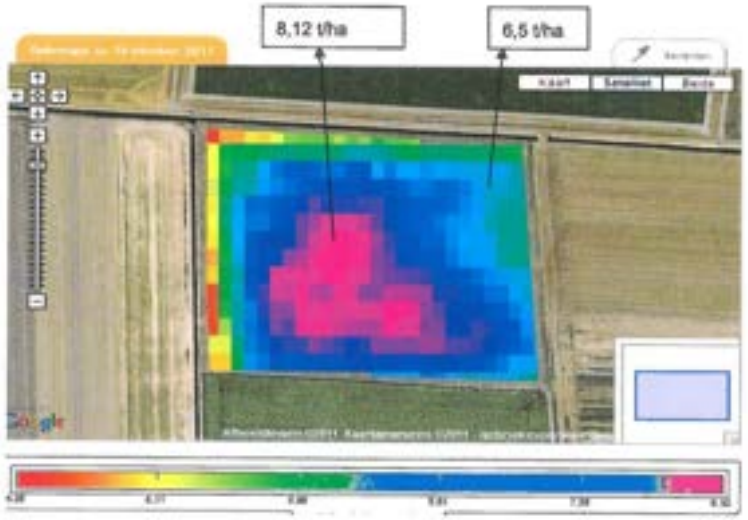
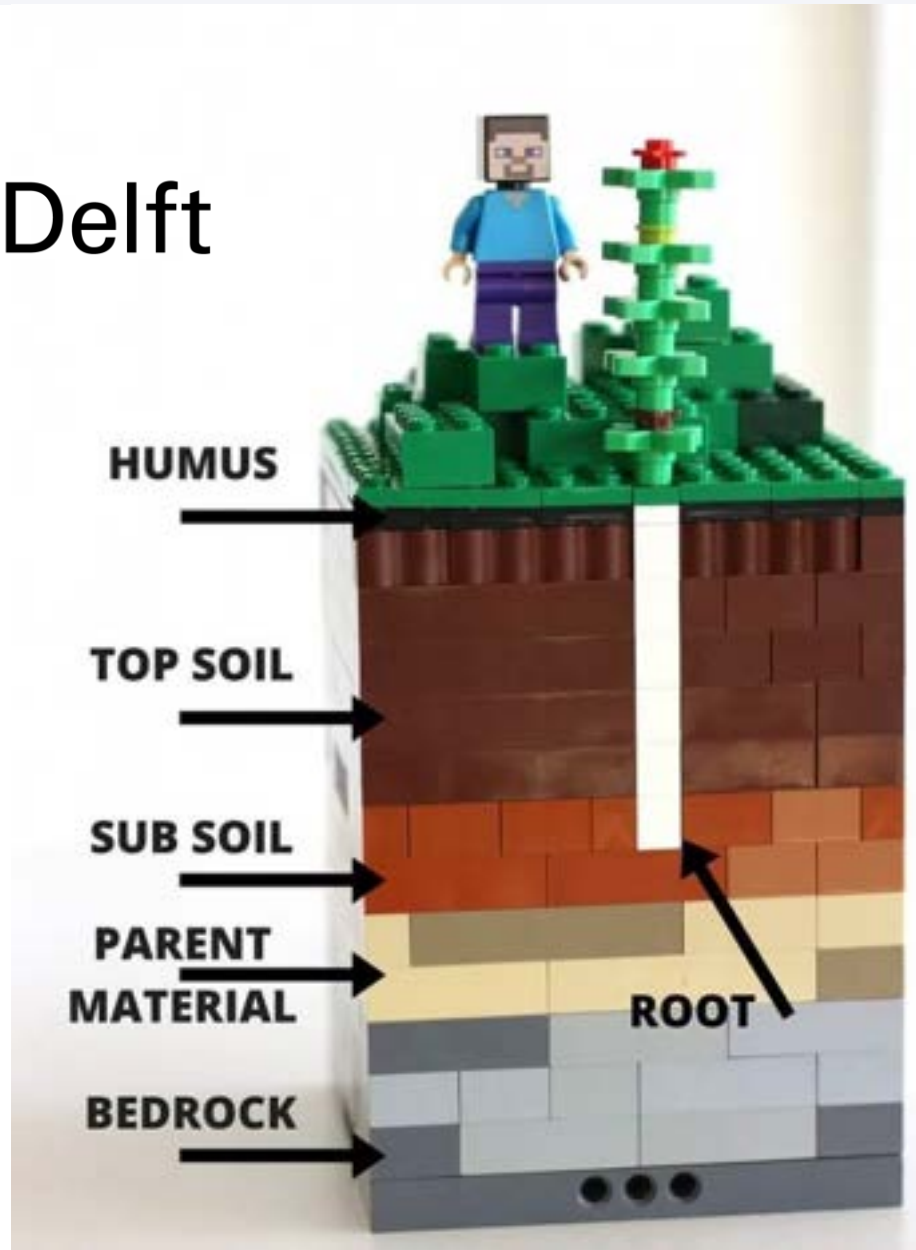
Testing for Life



# Personal introduction



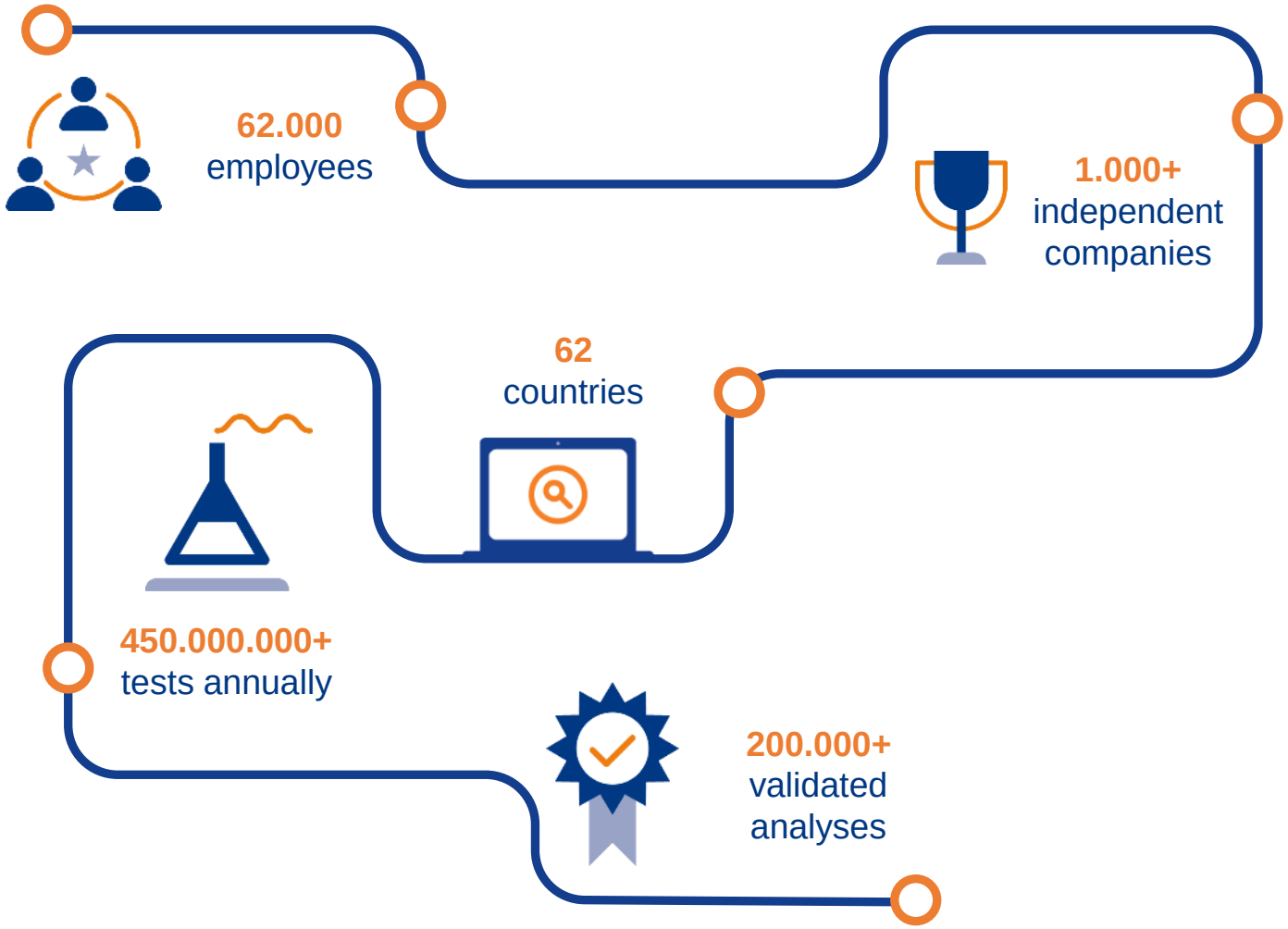




# Agenda

- Introduction Eurofins
- How to take a soil sample?
- Measuring Soil Health
- Submitted questions
- Surprise

# Eurofins Scientific



# Origin of Eurofins Scientific

## Authenticity is our origin

In 1987, the parents of the current CEO, Gilles Martin developed an authenticity method to detect the origin of grapes in wine in order to prevent wine fraud.

This technique, the SNIF-NMR technique is the origin of the global concern today with 940 labs, 61.000 people in 55 countries.The name ‘fins’ from the name Euro*fins* comes from ‘snif’.

# History International Business Line Eurofins Agro Testing

**1997**
Eurofins listed on the “Nouveay Marché”, The Paris Stock Exchange in October 1997

**2007**
Eurofins takes over Analyzen in Kristianstadt in Sweden

**2013**
Eurofins takes over BLGG in the Netherlands

**2016**
Acquisition Relab den Haan in the Netherlands

**2019**
Eurofins Agro takes over Laboratoire Galys in France

**2023**
Acquisition Corteva Lab in Germany

Acquisition lab SRUC in Scotland

**1927** — **2025**

**1927**
Founding of BLGG in the Netherlands by association of Dutch farmers

**2006**
Eurofins acquires AUA GmbH in Germany

**2012**
Acquisation of Viljavuuspalvelu Oy in Finland

**2013**
Acquisition Lab Zeeuws-Vlaanderen in the Netherlands

**2019**
Acquisition Minerag Lab in Hungary

**2022**
Acquisition OK-lab in Denmark

**2024**
Acquisition lab NIK group Bulgaria and Romania

# Eurofins Agro


**An international footprint**

**…with deep agricultural expertise**

- A growing network of **19** agricultural laboratories (our oldest was founded in 1927!)

**A unique offer:**

1. **A local service**
2. **An international partner**


eurofins
TOGETHER FOR A GREEN TOMORROW
OUTCOME BASED ENTREPENEURSHIP
INTERNATIONAL STANDARDISATION
SCALABLE SYSTEM
TESTED BY EUROFINS
SDGs
A B C D E
URBAN/ INDUSTRY
NATURE/FOREST
FARMERS/ GROWERS
RETAIL/FOOD
POLICY, GOVERNMENT & SCIENCE
SUPPLIERS/ ADVISORS
PHYSICAL
BIOLOGICAL
CONTAMINANTS
CARBON
CHEMICAL
SOILL
STARTUP

# How to take a soil sample?

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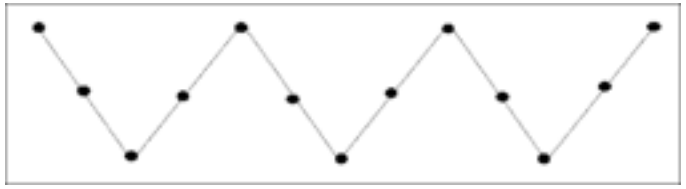
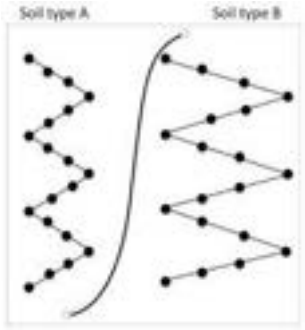
# How to sample?

## What do you want to sample?

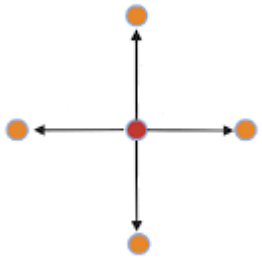
- Field



- Zone




- Point



## Which depth are you interested in?

- Grass: 0-10cm
- Arable land: 0-25cm
- Multiple layers: 0-30; 30-60; 60-90

# How to sample?

## Which equipment to use?

- Soil probe



# How to sample?

## Sampling protocol

https://www.eurofins-agro.com/en/sending-samples/how-to-take-a-sample

# Measuring Soil Health

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# Routine soil surveys for farmers since 1927

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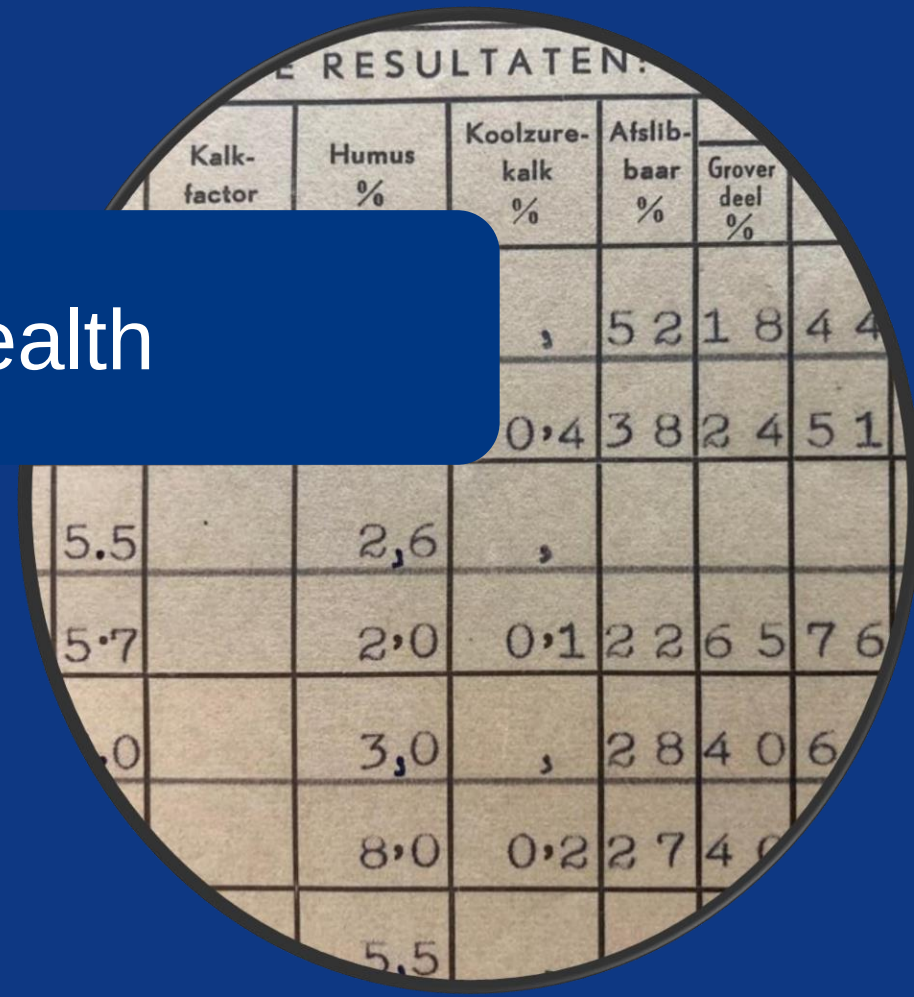
## Increased attention in Soil Health

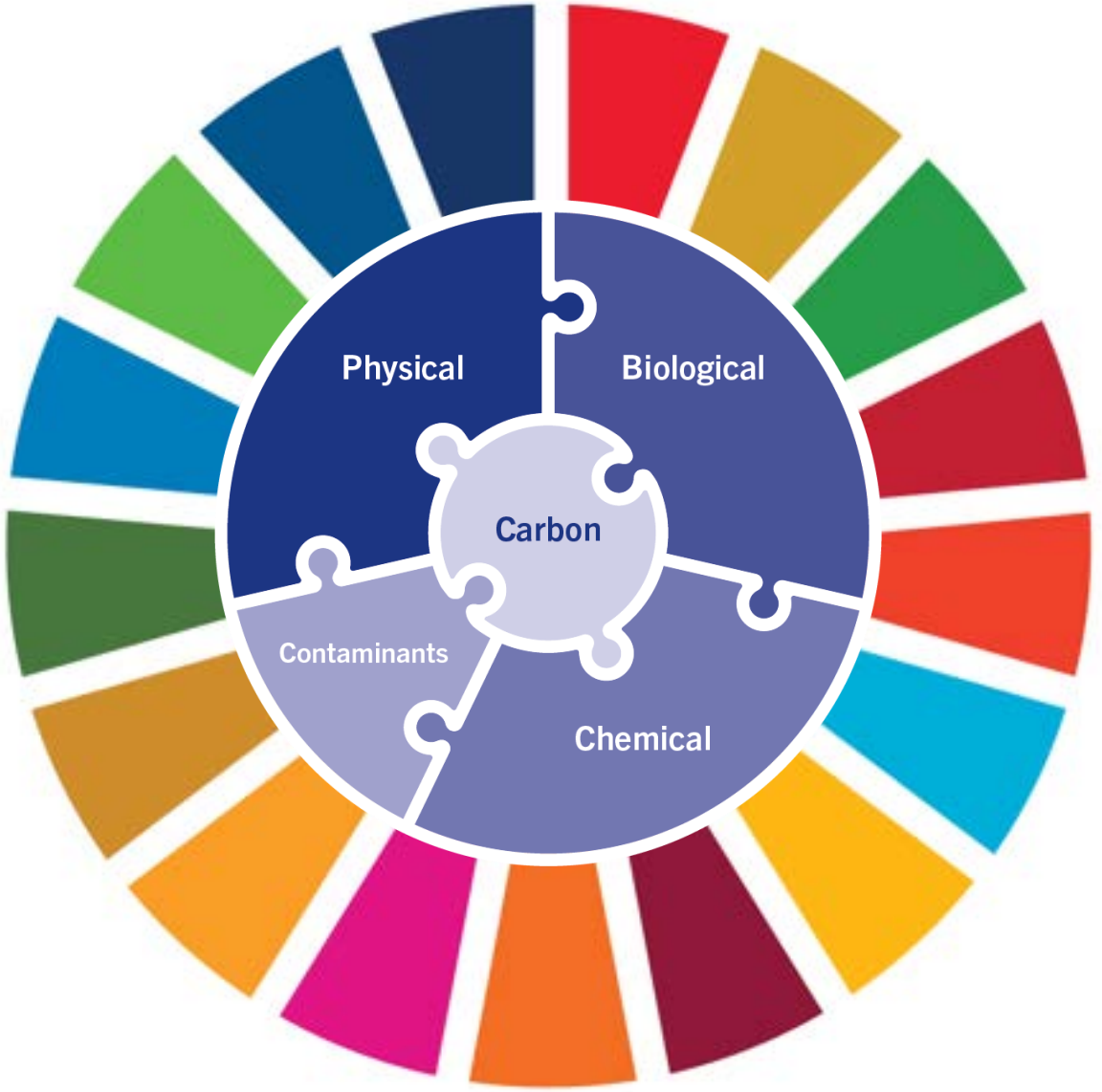


# Soil Health: farmers/growers and agri-food-industry

# Soil Health: Research and Government/legislation

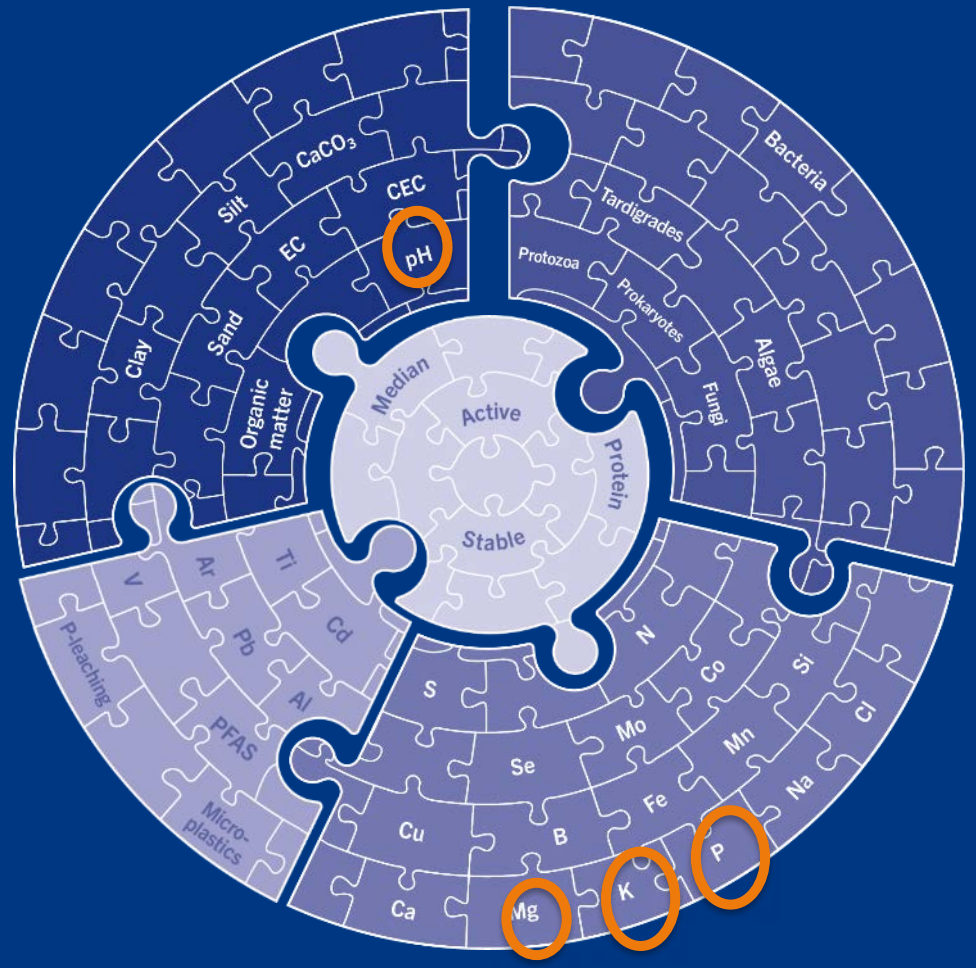

- SDG 2015 accepteed by 193 countries
- European Green Deal 2019
- European Directive on Soil Monitoring and Resilience 2023
- 4/1000 initiative Paris (COP21) (https://4p1000.org)
- Platform of Latin America and the Caribbean for Climate Action on Agriculture (PLACA)
- Adapting African Agriculture (AAA)
- Living Soils of the Americas (IICA)
- The National Action Plan for the implementation of the 2030 sustainable development agenda VIET NAM

# What is Soil Health ?



# Routine soil testing: often only a few soil indices

- P, K, Mg, pH
- P, K, Mg, pH
- P, K, pH
- P, K, Mg, SOM, pH
- pH, S, Olsen-P, K, Mg, Ca, Na

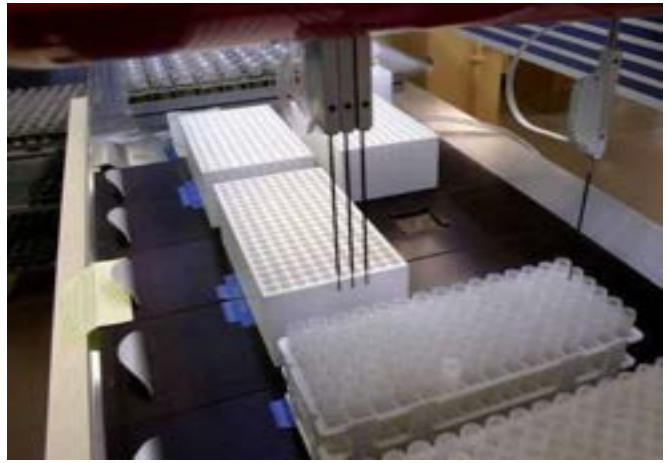



*Bünemann, E. K., Bongiorno, G., Bai, Z., Creamer, R. E., De Deyn, G., de Goede, R., Fleskens, L., Geissen, V., Kuyper, T. W., Mäder, P., Pulleman, M., Sukkel, W., van Groenigen, J. W., & Brussaard, L. (2018). Soil quality – A critical review. Soil Biology and Biochemistry, 120, 105–125.*

# Traditional soil analysis

- Many different parameters, many different chemical analytical methods
  - Time consuming
  - Expensive
- Important soil characteristics like soil texture, CEC and soil life difficult to implement on routine basis
- Inhibits innovation

**Eurofins developed an alternative…**



# An innovative method to test soil health: NIRS

- Near Infra-Red Spectroscopy (NIRS) as rapid broad-spectrum soil test in dried soil

- <40 seconds
- >100 soil indices

- Water disturbs the NIR signal and acts like a fog, resulting in less accurate analysis

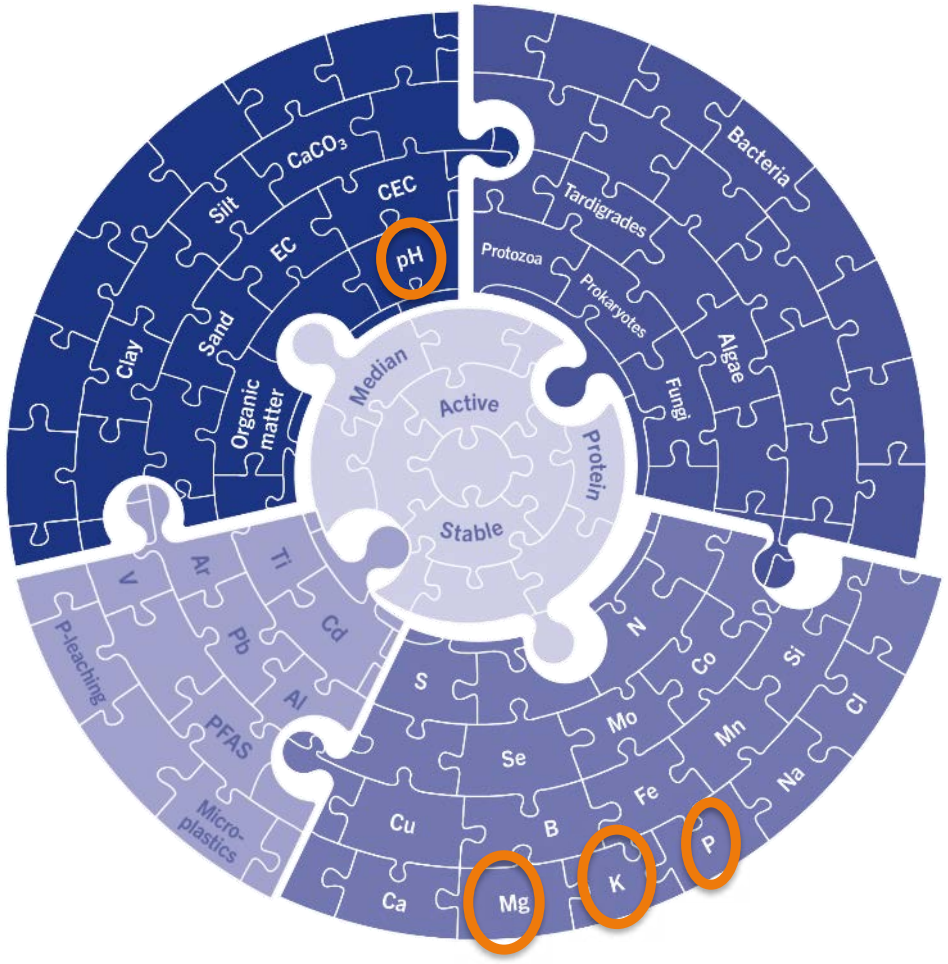
# An innovative method to test soil health: $CaCl_2$

- 0.01 M $CaCl_2$ measures plant available main + micro (and beneficial) nutrients
  - $NO_3$, $NH_4$, DON, S, P, K, Mg,
  - Na, Fe, Zn, Mn, Cu, Mo, Ni, B and Co, Se, Si
  - Bio available (heavy) metals like Cd, Al, Cr, Pb

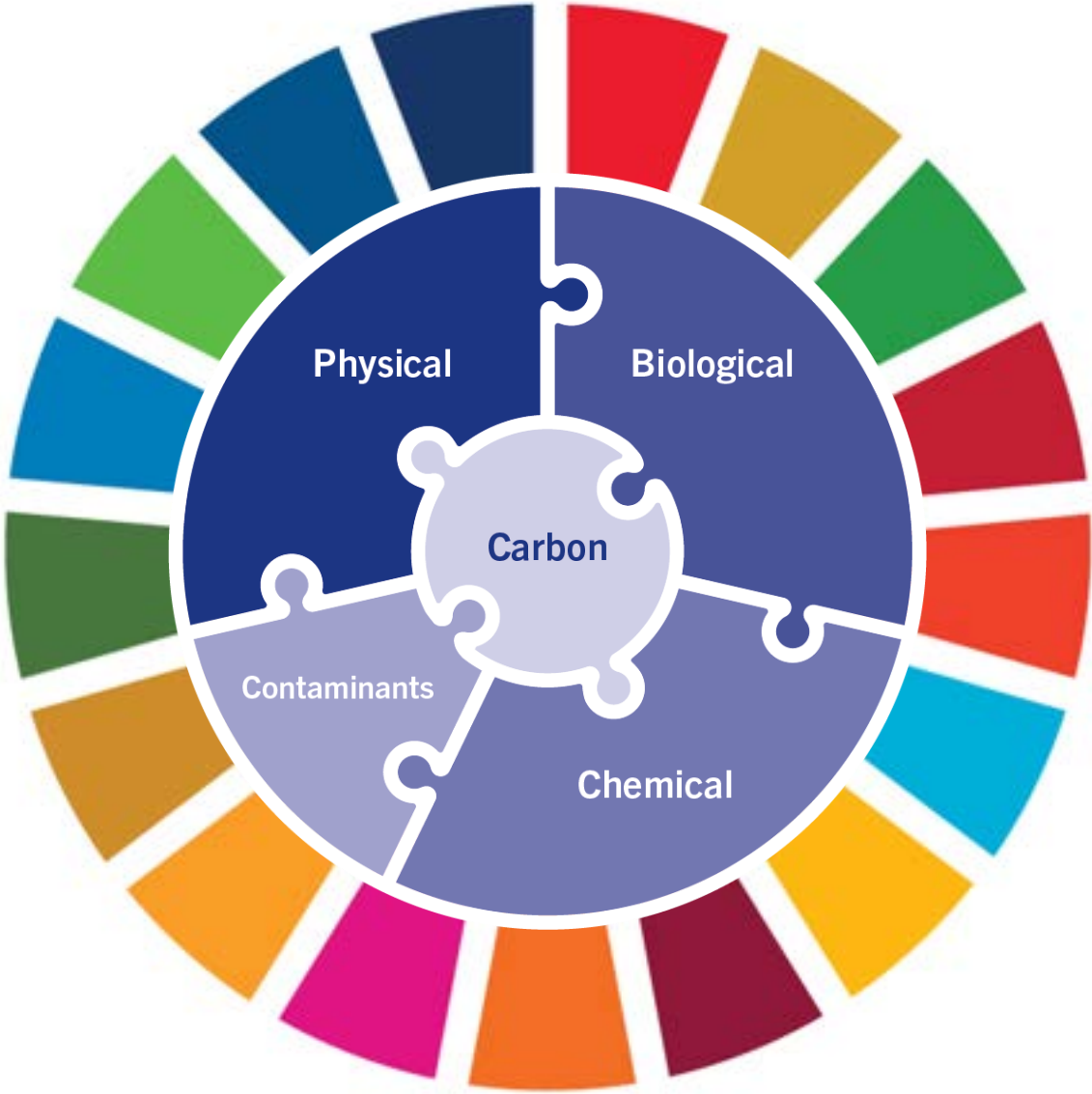

*Literature*

- *Houba V.J.G., Novozamsky, I., Lexmond, T.M. & Van der Lee, J.J. 1990. Applicability of 0.01 M CaCl2 as a single extraction solution for the assessment of the nutrient status of soils and other diagnostic purposes. Communications in Soil Science and Plant Analysis, 21, 2281 – 2290*
- *Houba V.J.G., Novozamsky, I. & Van der Lee, J.J. 1994. Status and future of soil and plant analysis. Communications in Soil Science and Plant Analysis, 25, 753 – 765.*
- *Houba, V.J.G., P.J. van Erp, M. Fotyma, J. Loch & J. Baier. 1996. Development and testing of a universal soil extraction method for the evaluation of soil fertility and soil pollution. Communications in Soil Science and Plant Analysis, 27, 233.*
- *Van Erp, P.J. 2002. The potentials of multi-nutrient soil extraction with 0.01 M CaCl2 in nutrient management. PhD thesis Wageningen University, The Netherlands.*
- *Miles et al. (2014) promoted Si-0.01 M CaCl2 for sugar cane in South Africa*
- *K-0.01 M CaCl2 showed a high correlation with rice parameters in Iran by Kavoosi et al. (2003)*
- *Finger millet yield (India) was positively and significantly correlated with K-0.01 M CaCl2 (Srinivasarao et al., 2014),*
- *Sürücü et al.,2013 (Turkey) found that Mn-0.01 CaCl2 was the best out of 16 soil tests to relate to tea parameters, and*
- *Spargo et al. 2017 (USA) used it for S determination in field and forage crops.*

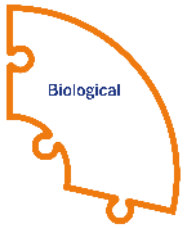
# So…

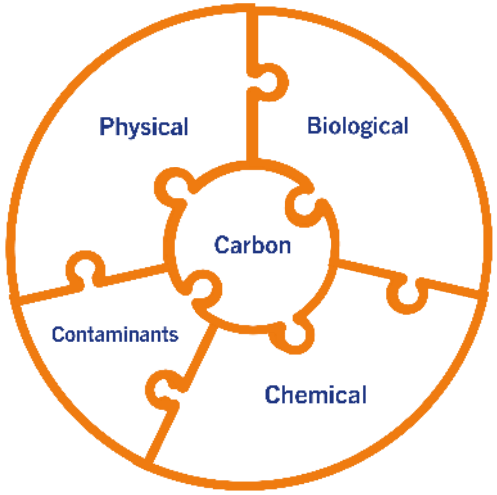

Clay
Silt
Sand
Organic matter
$CaCO_3$
CEC
EC
pH
Bacteria
Tardigrades
Protozoa
Prokaryotes
Algae
Fungi
Median
Active
Protein
Stable
V
Ar
Ti
Cd
Pb
Al
P-leaching
PFAS
Micro-plastics
S
N
Co
Si
Se
Mo
Mn
Cl
Fe
Na
Cu
B
P
Ca
Mg
K

Or


Physical
Biological
Carbon
Contaminants
Chemical

# We created products for farmers, growers, agri-food, government





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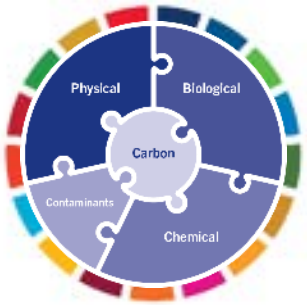
# Soil Health Indicator





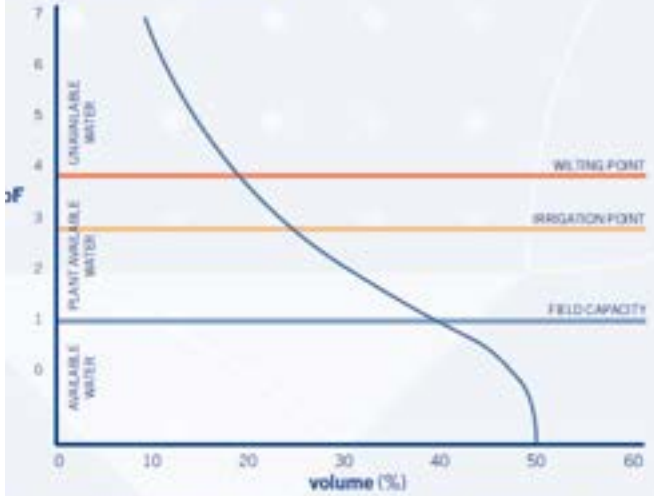
# Physical

## The Foundation

### Soil composition

| | % | | |
|---|---|---|---|
| Clay | 27 | Carbonate lime ($CaCO_3$) | 5.0 |
| Silt | 33 | Soil organic matter (SOM) | 4.0 |
| Sand | 31 | | |

### Water holding capacity




| | | | |
|---|---|---|---|
| Plant available water, mm | 60 | Irrigation point, % | 11.4 |
| Field capacity, % | 30 | Wilting point, % | 6.0 |

## Prudent use of water and nutrients

### pH

| | - |
|---|---|
| pH_$CaCl_2$ | 7.3 |
| pH_water | 6.8 |

### Soil density

| | g/cm3 |
|---|---|
| Soil particle density | 2.6 |
| Soil bulk density | 1.2 |

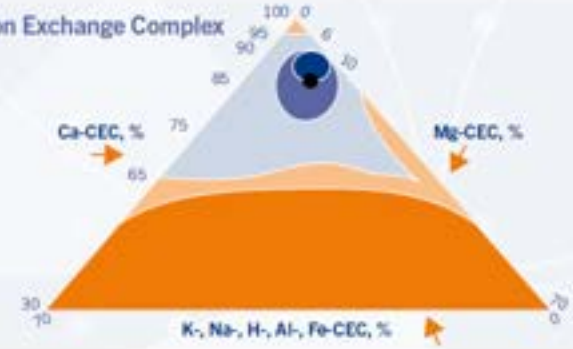
### Salt indices

| | |
|---|---|
| Na-plant available, g/kg | 3.4 |
| Na-soil stock, mmol⁺/kg | 3.4 |
| Exchangeable sodium (ESP), % | 6.5 |
| Sodium absorption ratio (SAR) | 6.8 |
| Electrical conductivity (EC), mS/cm25°C | 0.86 |

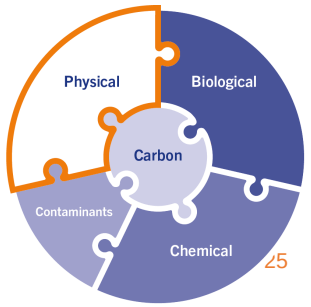
### Soil structure

| | Score |
|---|---|
| Risk soil slaking | 1.3 |
| Risk on wind erosion | 5.5 |
| Potential risk soil structural | 2.8 |

### Cation Exchange Complex




| | |
|---|---|
| *Effective CEC, mmol⁺/kg* | *153* |
| Ca-CEC, % | 1.3 |
| Mg-CEC, % | 10 |
| K-CEC, % | 5 |
| Na-CEC, % | 1.5 |
| Base saturation, % | 6 |



# Biological

## Soil Biodiversity

### Regenerate soils

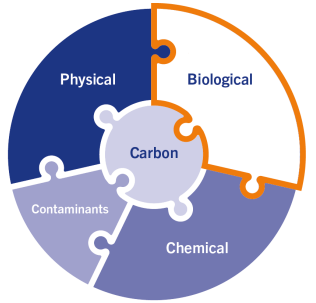
| Bacteria | mg PLFA/kg |
|---|---|
| Total bacteria | 10 |
| Gram positive | 5 |
| Actinomycetes | 1.5 |
| Gram negative | 2.0 |

| Protozoa | mg PLFA/kg |
|---|---|
| Protozoa | 0.16 |

| | |
|---|---|
| Microbial biomass | 13 |

| Fungi | mg PLFA/kg |
|---|---|
| Total Fungi | 1.3 |
| Saprophytes | 0.5 |
| Mycorrhiza | 0.8 |

| | |
|---|---|
| Fungi/bacteria ratio | 9/1 |
| Gram (+)/Gram(-) ratio | 10/1 |
| Diversity index | 3.2 |



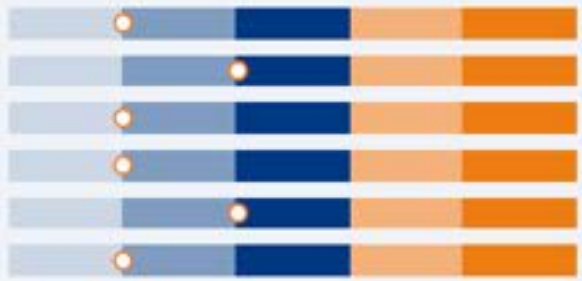
# Carbon

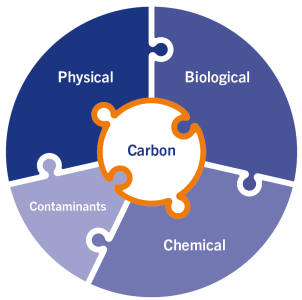
## Carbon Storage

| | | kg C/ha | Ton $CO_2$/ha |
|---|---|---|---|
| Soil organic carbon (SOC),% | 1.60 | 58,320 | 58 |
| Soil inorganic carbon (SIC), | 0.10 | ... | ... |
| Total soil carbon (TC), % | 1.70 | ... | ... |
| C in microbial biomass, mg C $kg^{-1}$ | 369 | ... | ... |
| C in bacterial biomass, mg C $kg^{-1}$ | 99 | ... | ... |
| C in fungal biomass, mg C $kg^{-1}$ | 91 | ... | ... |
| Active C (POXC), mg C $kg^{-1}$ | 91 | ... | ... |

## Beat climate change

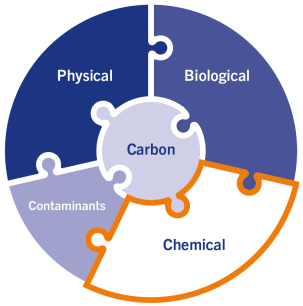
| | |
|---|---|
| Soil organic matter (SOM), % | 3.10 |
| Carbon in soil organic matter, % | 52 |
| Nitrogen in soil organic matter, % | ... |
| Sulphur in soil organic matter, % | ... |
| C/N ratio | 10/1 |
| C/S ratio | 62/1 |
| Clay/SOC ratio | 6/1 |





# Chemical


Essential nutrients
High food & feed quantity & quality
Main nutrients
g/kg
kg/ha
N-plant available (mineral N) 3.4 30
Total N stock 3.4 30
S-plant available 3.4 30
Total S stock 3.4 30
P-plant available 3.4 30
Total P stock 3.4 30
K-plant available 3.4 30
K-soil stock 3.4 30
Ca-plant available 3.4 30
Ca-soil stock 3.4 30
Mg-plant 3.4 30
Mg-soil stock 3.4 30
Not available
low
rather low
good
rather high
high
high
good
low
Plant available
Soil stock
N
S
P
K
Ca
Mg
Micro nutrients
µg/kg
kg/ha
Fe-plant available 3.4 30
Mn-plant available 3.4 30
Ni-plant available 3.4 30
Cu-plant available 3.4 30
B-plant available 3.4 30
Mo-plant available 3.4 30
Cl-plant available 3.4 30
Not available
low
rather low
good
rather high
high
too high
Plant available
Soil stock
Fe
Zn
Mn
Ni
Cu
B
Mo
Cl
Si
Co
Se
Beneficial nutrients
µg/kg
kg/ha
haSi-plant available 3.4 30
Co-plant 3.4 30
Se-plant 3.4 30
Ratio (plant available)
Ca/Mg
Ca/K
Mg/K


Physical
Biological
Carbon
Contaminants
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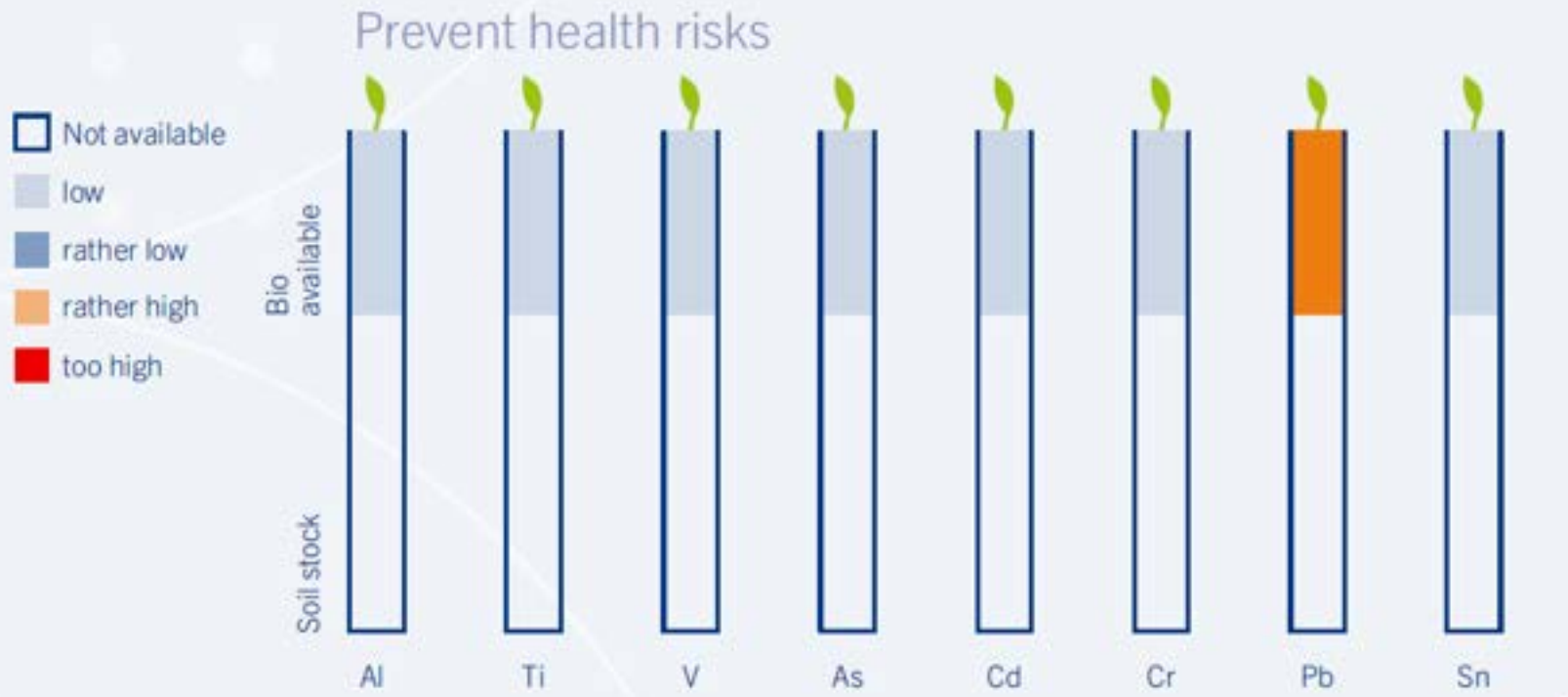
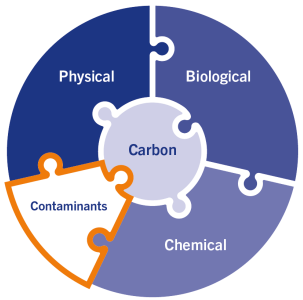
# Contaminants

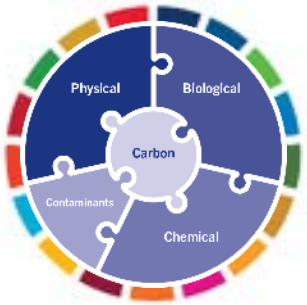
## Potential contaminants

| Bio available metal | µg/kg | kg/ha |
|---|---|---|
| Aluminium (Al) | 3.4 | 30 |
| Titanium (Ti) | 3.4 | 30 |
| Vanadium (V) | 3.4 | 30 |
| Arsenic (As) | 3.4 | 30 |
| Cadmium (Cd) | 3.4 | 30 |
| Chromium (Cr) | 3.4 | 30 |
| Lead(Pb) | 3.4 | 30 |
| Tin (Sn) | 3.4 | 30 |

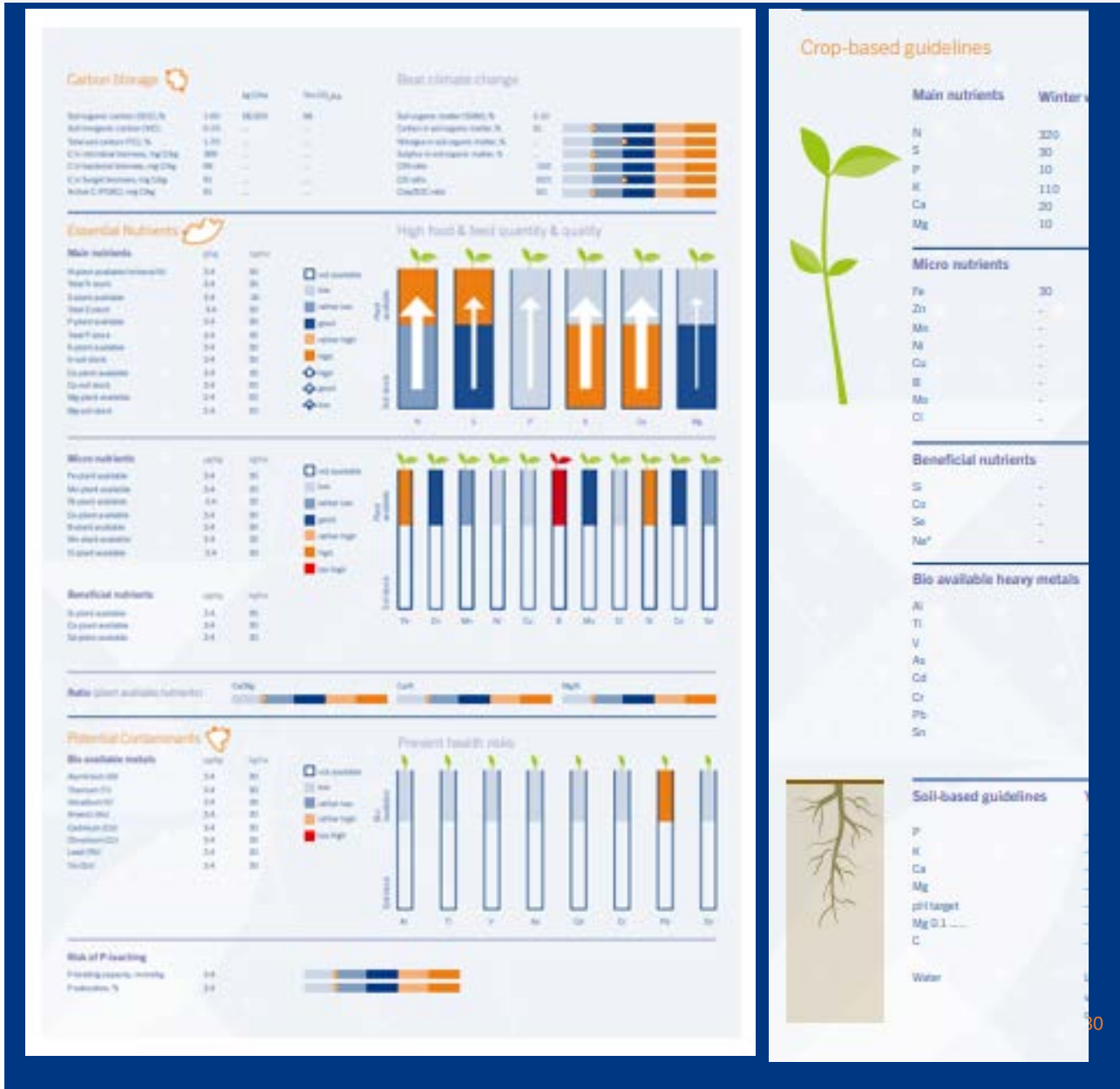


# Recommendations and a score





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# And there is more…

## Routine

The Soil Health Indicator combines all relevant available routine measurements

## Specials

Slower, more expensive or less routine measurements may be relevant as well

- Nematodes
- DNA-profiling
- PFAS
- Chemical residu
- …

# Submitted questions

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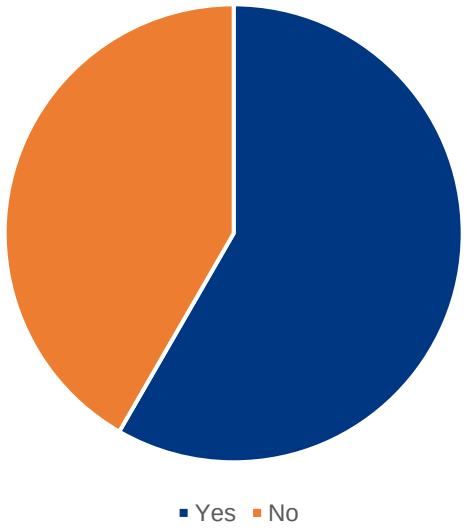
# Your experience

Have you already taken soil samples in your living labs?




- Soils are **very varying**. Even within the same agrarian plot.
- Variable climate conditions would affect the timely soil sampling.
- Very engaged farmers **eager** to start implementation.
- It takes a long time (in particular the measurement of bulk density)
- Good, but **challenging to harmonise** collection, analysis, methodologies...
- Physico-chemical characteriztion (texture, pH, conductivity, water content, organic matter, heavy metal traces, ions (Mg; Ca; K; Na); total microbial biomass.
- I have experience in soil sampling for biodiversity, soil fertility, utilisation of simplified tools to assess soil porosity, ecological classification of earthworms...

# soil monitoring tools, data collection, number of samples for site, experimental design

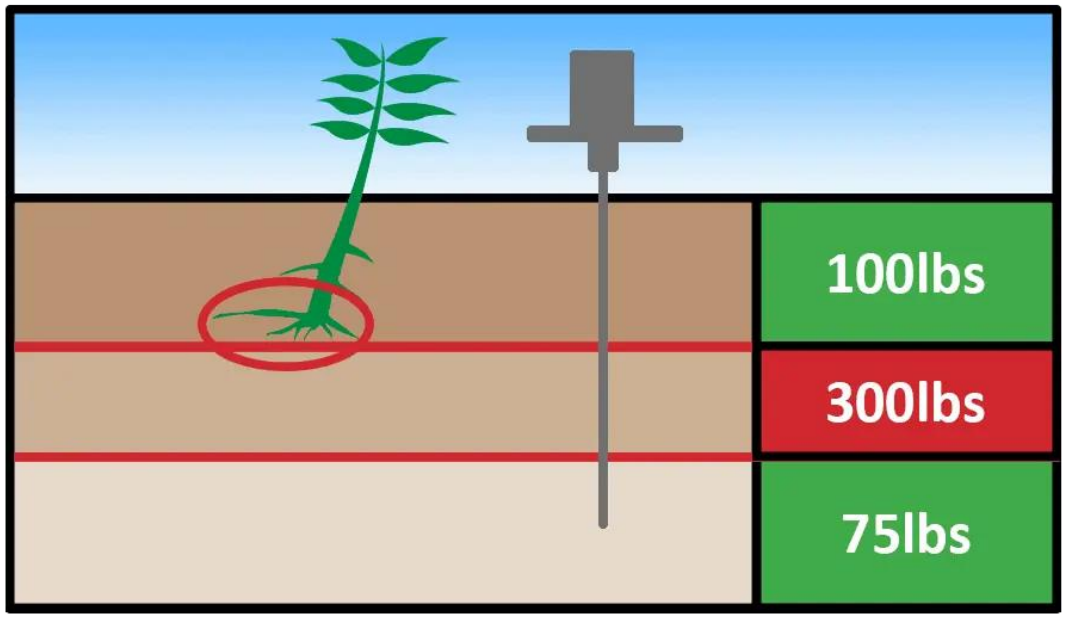
**It depends**

- Design based on your ambition and research interest.
- Results should be intercomparable

# What is the best indicator to monitor the status of soil compaction?

## Compacted layers

- Measure compaction with penetrometer
- Visualize compacted layers with a profile pit



# Assessment of soil density?

## Ring

- Labor intensive
- Prone to sampling errors

## Tube

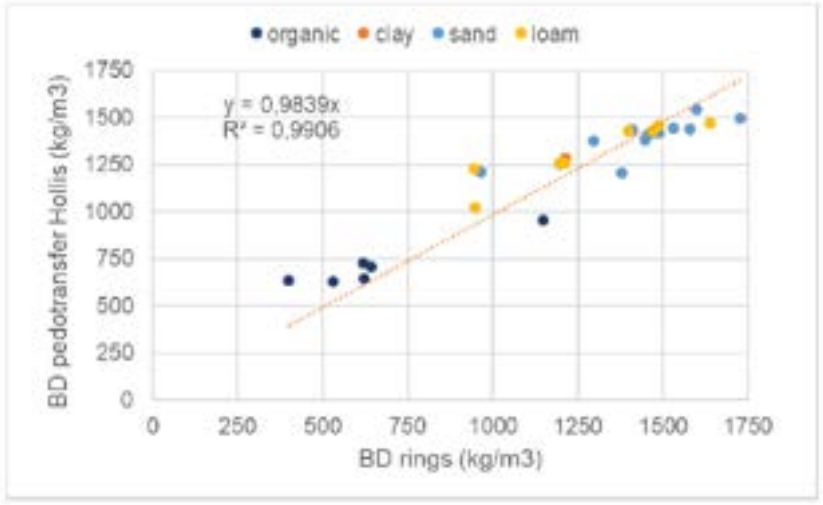
- Less prone to sampling errors

## Pedotransfer

- Hollis, J.M., Hannam, J. and Bellamy P.H. 2011. Empirically-derived pedotransfer functions for predicting bulk density in European soil. European Journal of Soil Science

## NIRS

- Reference method: Hollis, measure soil structure to calculate bulk density





Rings and tubes give a local value. Is this **representative** for the field?

# What kind of microorganisms is more interesting to have information about in the soil? pathogens, biotechnological potential?

## What is your purpose?

- PLFA
  - Quick and cost effective, routine research
  - Insight in bacteria, fungi, protozoa
- Nematodes
  - More time consuming and expensive
  - Free-living vs plant parasitic
- DNA-profiling
  - Many measurements
  - Currently limited understanding
- Species mapping

# Principles in soil sampling and storage before analyses, mainly for microbiological characterization.

## PLFA analysis

- Store sample at a cool place (< 8°C) and start the analysis within 4 days
- Alterative: freeze the samples after sample taking

# What monitoring approaches and tools you could recommend as feasible at the EU level.

## Criteria

- Available throughout the EU
- Robust / fool-proof
- Replicable
- In-line with policy and scientific findings

# 4 in 1

## Sensitivity of indicators in the short-term

- Improving Soil Health takes years
- Look at the complete picture

## Harmonisation with other Soil Mission Projects

- LUCAS
- EU legislation
- Transfer functions

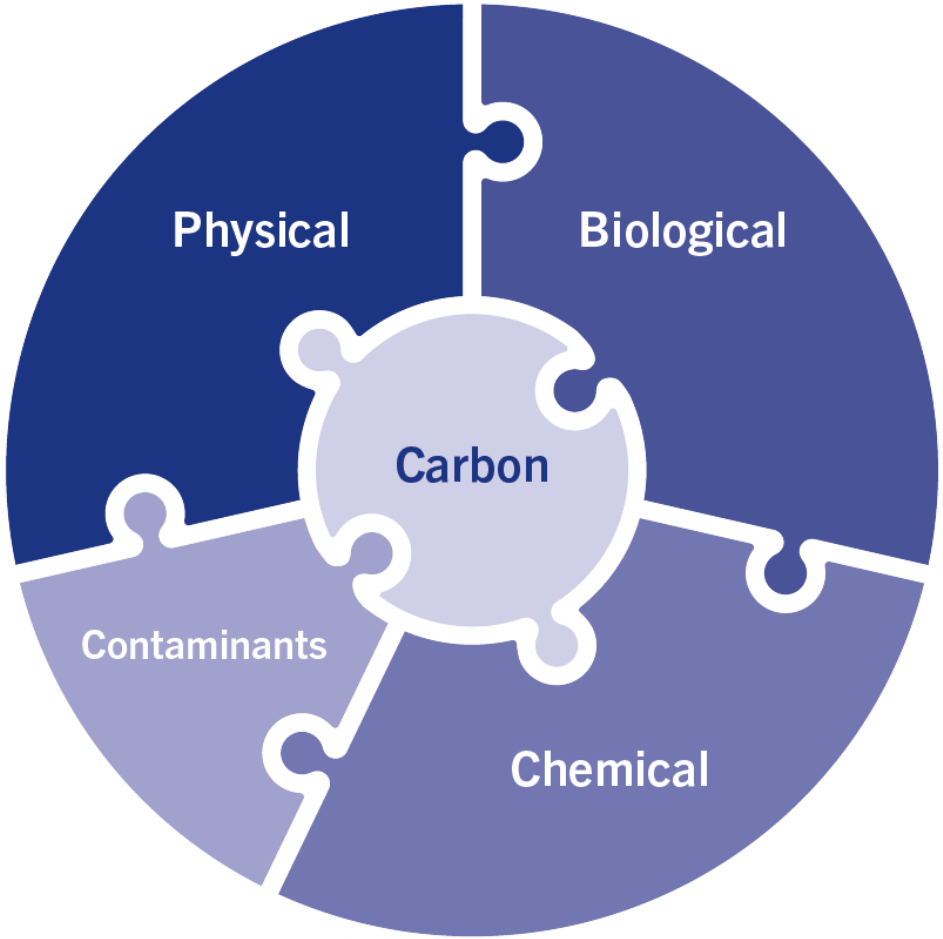
## Wide spectrum of soil indicators (traditional soil parameters, social, economical indicators...)

- Measure and follow all aspects of soil health

# I would like to know about the best indicators of soil health monitoring.

**Only one?**

- The “best” indicator depends on place, time and purpose
- Measure all aspects that are routinely available
- Results may stimulate to dive deeper on aspects



# Surprise

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Testing for Life

# Next steps

- Each Living Lab can submit 2 soil samples to be analyzed with the Soil Health Indicator
- Results will be discussed during the bootcamp
- Practicalities will be organized through the Living Lab coordinators

soil systems

MDPI

Article

Transforming Agricultural Living Labs into Lighthouses Contributing to Sustainable Development as Defined by the UN-SDGs

Jan Adriaan Reijneveld, Mark Geling, Edwin Geling and Johan Bouma

Abstract: The UN Sustainable Development Goals (SDGs) were intended to be met by 2030, but recent reviews show that this will not be achieved, and recommendations have been made to heads of state, governments, the international community, and member states to strengthen their efforts. Focusing on agriculture, we argue that a bottom-up effort is also needed in living labs, one that truly involves farmers, as they are now confused about, and resistant to, top-down rules and regulations. To provide clarity, we suggest the following: (i) selecting key SDGs by considering the proportionality principle, and (ii) defining ecosystem services in terms of indicators and thresholds for income, the production of healthy food, the protection of water quality, contribution to energy preservation and climate mitigation, and the protection of life on land, including soil health (SDGs 1, 2, 3, 6, 7, 13, 15). Indicators and thresholds have to be clear and measurable and achievable within reasonable costs. The introduction of innovative sensing techniques allowed the rapid generation of relevant soil data in the field of living labs. When meeting all thresholds, a "lighthouse" is established to act as an inspiring example for farmers with similar soils in a given region. Policies should focus on achieving thresholds of a set of indicators rather than on prescribing certain top-down management measures.

Keywords: SDGs; ecosystem services; soil health; indicators; thresholds; participatory research

1. Introduction

For many years, sustainable development was an abstract concept that could be widely supported, as many interpretations of the concept were possible. Who would disagree? This changed in 2015 when 17 specific goals with targets and indicators were proposed and accepted by 193 governments at a UN Session in New York. However, since that time, implementation has not proceeded to adequately reach the goals by the intended deadline of 2030. The 2023 progress report (https://sdgs.un.org (last accessed on 20 June 2024)) showed that, of the 140 targets, only 12% are on track, 48% are moderately or severely off-track, and 30% show no progress. The Secretary General of the UN, Mr. Antonio Guterres, is quoted in this progress report as saying, "*Unless we act now, the 2030 agenda will become an epitaph for a world that might have been*".

Five major recommendations are made in the UN progress report to improve the implementation process, but they are addressed to heads of state, governments, the international community, and member states. With due respect, we argue that this top-down focus may not be sufficiently effective as only a true bottom-up commitment of engaged stakeholders can, in our view, change developments in a positive direction. When focusing on agriculture, farmers are the largest group of stakeholders. For them, due to poor communication, the SDGs and proposed targets and indicators are, at this point in time, still rather abstract top-down concepts, while the connection with their actions remains largely

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Testing for Life

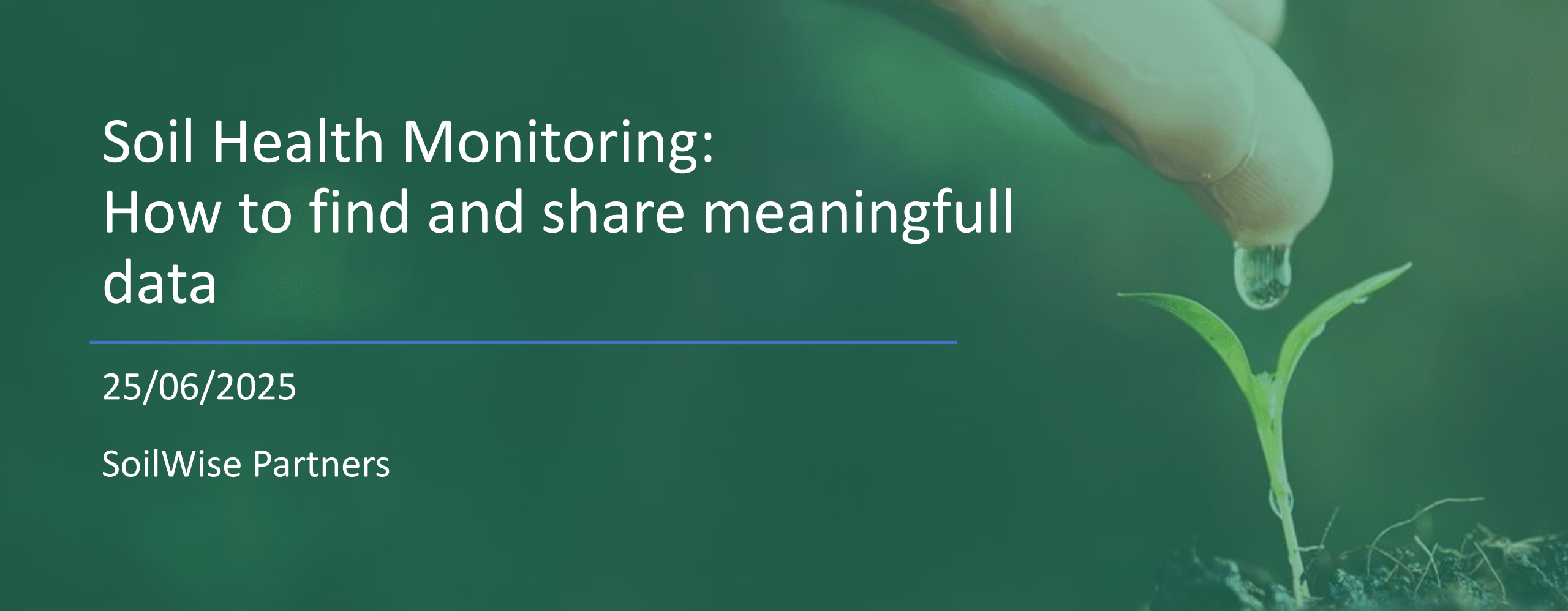
# Thank you

Maurits.Voogt@ftbnl.eurofins.com

# Soil Health Monitoring: How to find and share meaningfull data

25/06/2025

SoilWise Partners



Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

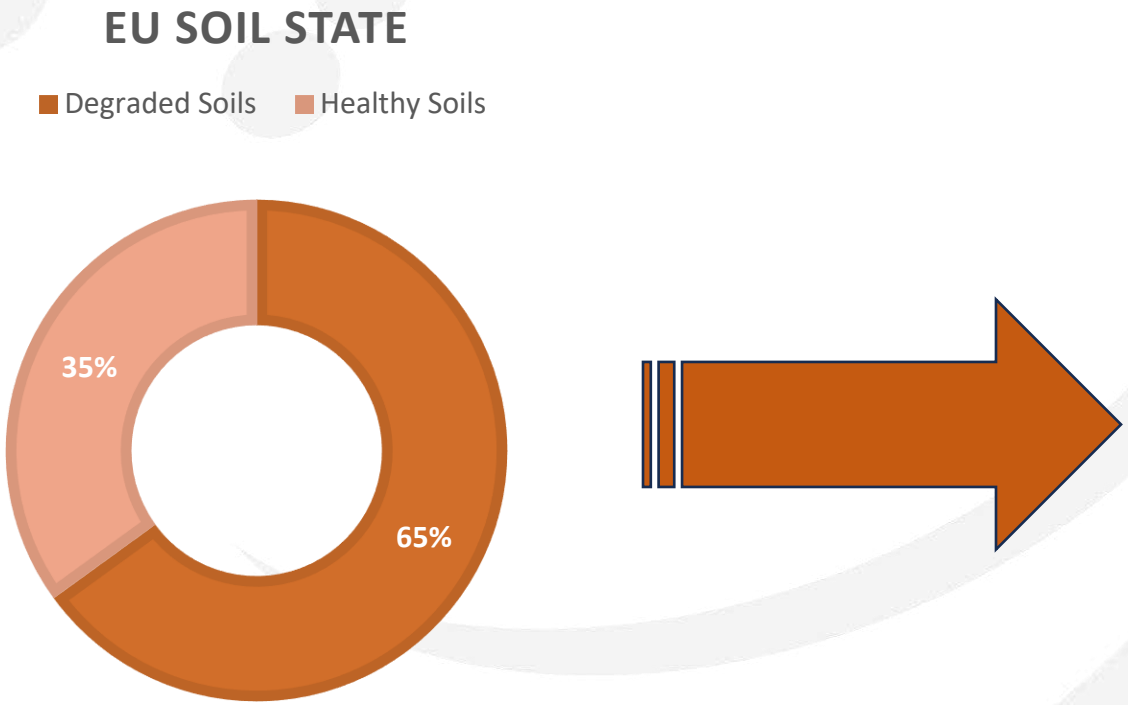
SOILL

SoilWise KNOWLEDGE & DATA FLOWS

# What is SoilWise?

**Radu Giurgiu – Project Coordinator - ILVO**

# Soil Mission Project

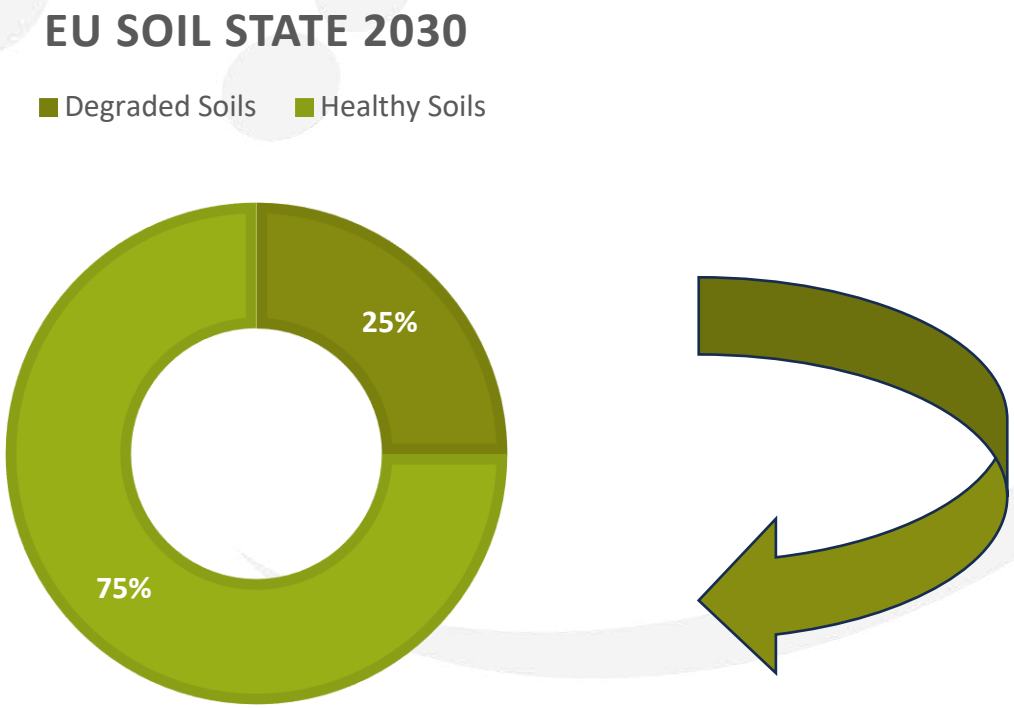



**€50** billion cost / year

Source: Soil Monitoring Law

Funded by the European Union
This project has received funding from the Horizon Europe research and innovation programme under Grant Agreement No 101112858

# Soil Mission Project




**€1** billion investment
100 Living Labs and Lighthouses
R&I projects

EUROPEAN UNION
EU MISSIONS
SOIL DEAL FOR EUROPE

SOILL STARTUP

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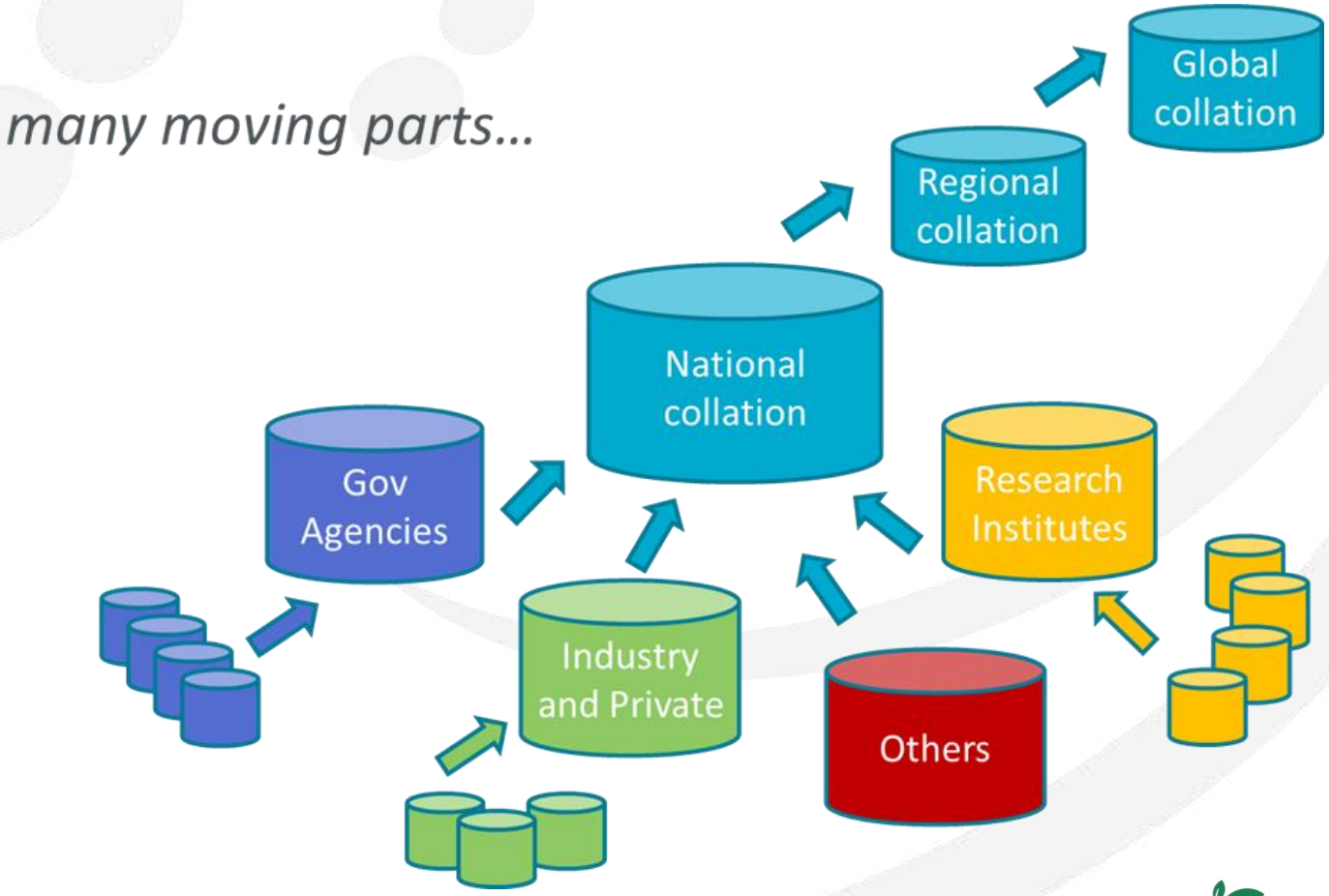
SoilWise KNOWLEDGE & DATA FLOWS

# Why the SoilWise project?




**Data availability**

- Hard to find / access / reuse
- Often stored locally or lost after project ends
- Duplicate monitoring across regions

**Data quality & interoperability**

- No shared vocabularies across projects
- Inconsistent units, classifications, formats
- Difficult to compare results between Living Labs

**Limits to learning & decision-making**

- Input data not standardized or annotated
- No metadata or context for reuse
- Can't link to EU-level tools like EUSO or SoilWise

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SoilWise KNOWLEDGE & DATA FLOWS

# SoilWise in a nutshell

DEVELOP, TEST AND DELIVER A PROTOTYPE FOR LONG-TERM KNOWLEDGE AND DATA REPOSITORY.

Expected to become part of EUSO (European Union Soil Observatory)

https://joint-research-centre.ec.europa.eu/eu-soil-observatory-euso_en

4 years

**Budget: €6 mil.**

1/9/2023 - 31/8/2027

15 Project partners from 9 countries

Develop a solution

5 practice-oriented "user cases"

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SoilWise KNOWLEDGE & DATA FLOWS

# Roadmap – where are we now?

Iterative approach: The project is split into 4 phases, and project phases are intentionally repeated, into three cycles


| Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Feb | Mar | Apr | May | Jun | Jul | Aug |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year 1 | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | Year 4 | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |
| | | | | | MS1 | | | | | | | MS2 | | | | | MS3 | | | MS4 | | | | | | MS5 | | | | | MS6 | | MS8 | | | | MS9 | MS10 | |

| Cycle 1 | | | | Cycle 2 | | | | Cycle 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CoDesign | Development | Integration & Validation | Demonstrate | CoDesign | Development | Integration & Validation | Demonstr | Integration | Demonstrate | | Delivery |

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SoilWise KNOWLEDGE & DATA FLOWS

# User-driven process

SoilWise Catalogue

Soil Companion

FAIRness Strategy

European Commission

Workshops, interviews

Requirements collection

Co-design, co-development

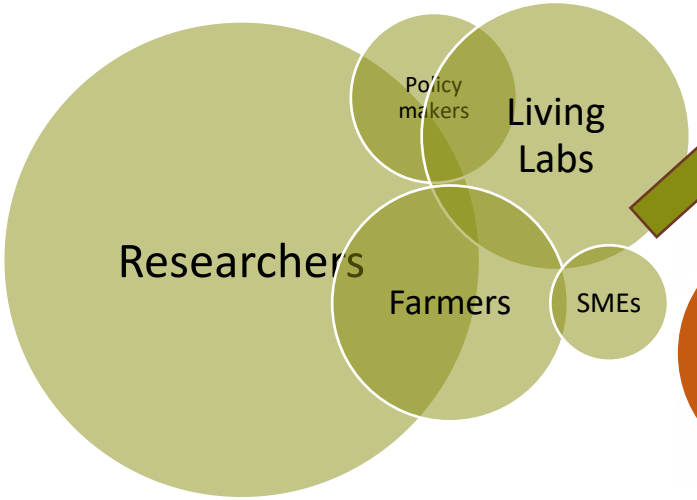
Co-validation

**EU Soil Observatory (EUSO)**

SoilWise KNOWLEDGE & DATA FLOWS

between 50+ to 100 Mission Soil Horizon Europe projects with data, knowledge and wishes






**Mission Soil Cluster on Knowledge and Data Management**

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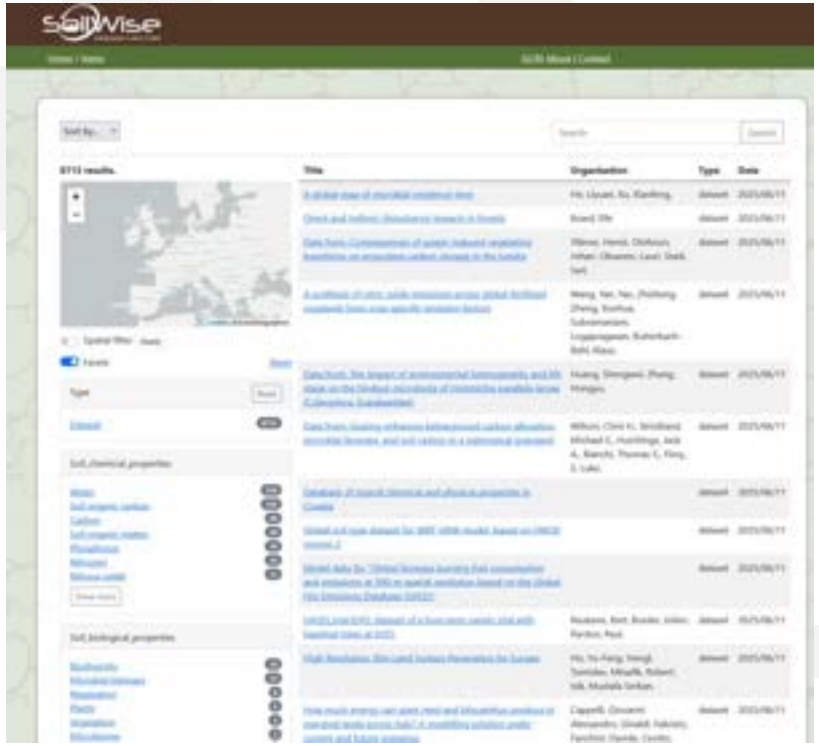
SoilWise KNOWLEDGE & DATA FLOWS

# SoilWise Repository (SWR) prototype launched




**SWR Harvests the following repositories:**

- INSPIRE geoportal
- CORDIS
- ESDAC
- Bonares
- EJP Soil
- PrepSoil
- Impact4Soil
- FAO Soils portal
- EEA Datahub
- ISRIC - World Soil Information

https://repository.soilwise-he.eu/

https://soilwise-he.eu/

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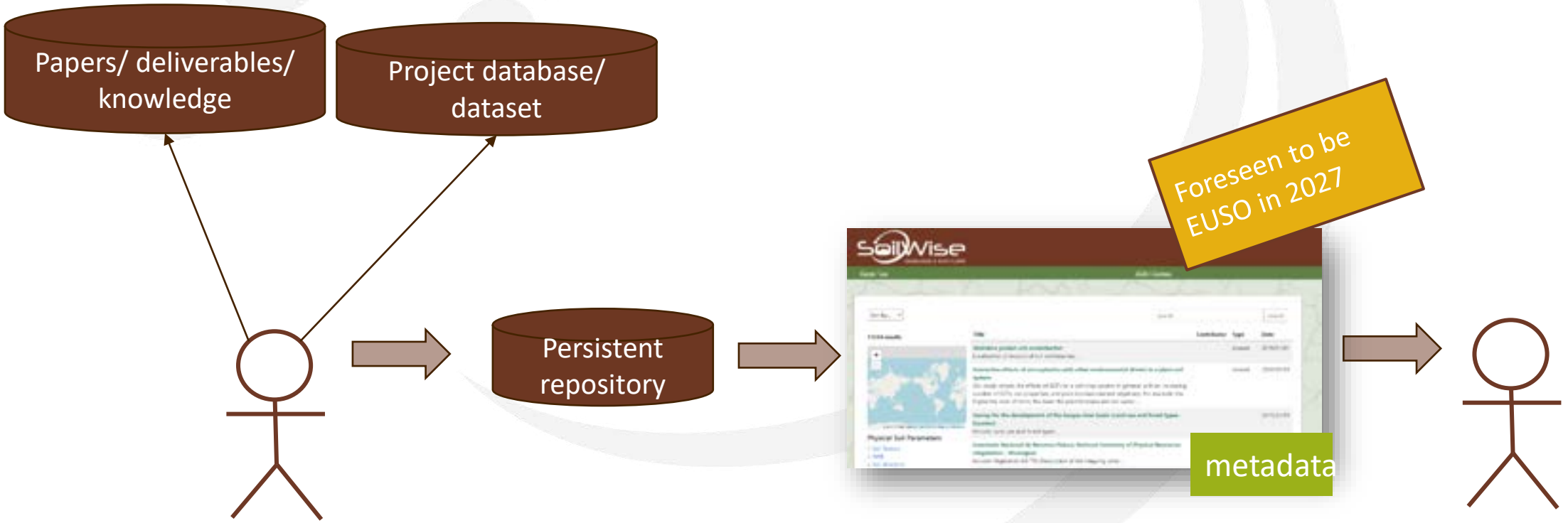
SoilWise KNOWLEDGE & DATA FLOWS

# Cooperation with the Mission Soil Projects and Living Labs

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SoilWise KNOWLEDGE & DATA FLOWS

# SoilWise principles

## SoilWise intention is:

- to provide a single access point to soil data and knowledge
- to index available data & knowledge
- to connect with existing catalogues
- to make providers' and users' lives easier

## SoilWise intention is NOT:

- to copy & store third party data
- to control third party data
- to steal third party  data
- to use third party  data without their permission

SOILL STARTUP

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SoilWise KNOWLEDGE & DATA FLOWS

# SoilWise collaboration effort


To develop a useful and functional Soil Data and Knowledge Infrastructure, the **collaboration efforts (and benefits from the outcomes) need to be mutual for all involved stakeholders**.

Data and Knowledge management Cluster,

Brussels, 2024

Funded by the European Union

This project has received funding from the Horizon Europe research and innovation programme under Grant Agreement No 101112838

SoilWise KNOWLEDGE & DATA FLOWS

# Demo

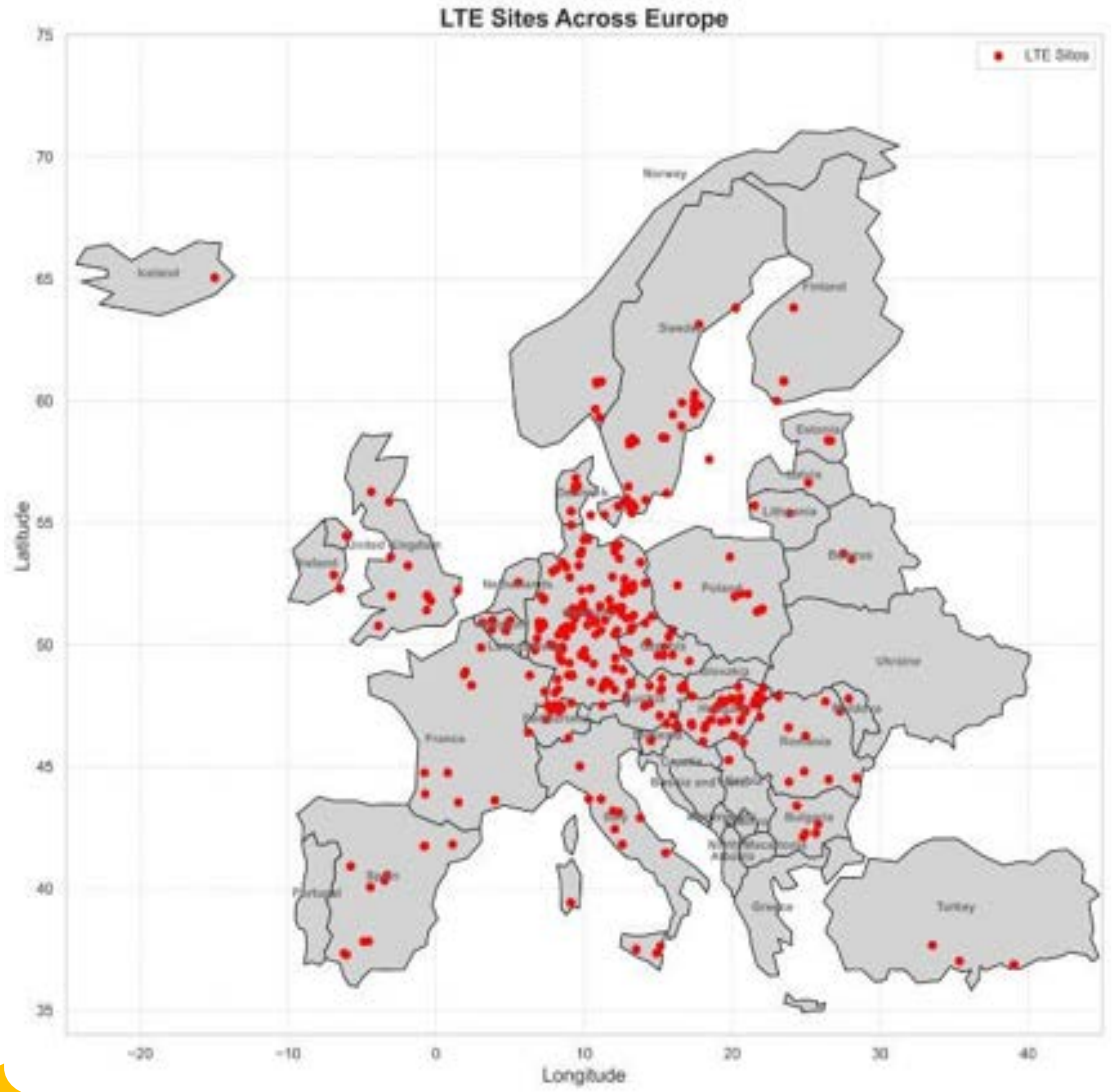
## How to search public datasets on soil health with the SWR

**Valeh Khaledi - ZALF**

# Introduction

## Using SoilWise to Access LTE Data for  Modeling

- **What This Demo Shows**
  - How **SoilWise** serves as a comprehensive platform to access data from repositories
  - The practical use of accessed data to support scientific analysis and modeling
- **What You'll See**
  - The **value of specific datasets** for soil and agroecosystem research
  - A **step-by-step use case**, from data access to modeling application
  - An example of **modeling** using real data from BonaRes (Repository)
  - How this approach supports **data translation across research, policy, and practice**




https://tools.bonares.de/ltfe/

Dönmez et al (2022)

# LTE : Long Term Experiment

**What?**

- LTE datasets = Long Term Field Experiment, consistent, and high-quality.

**Why is important?**

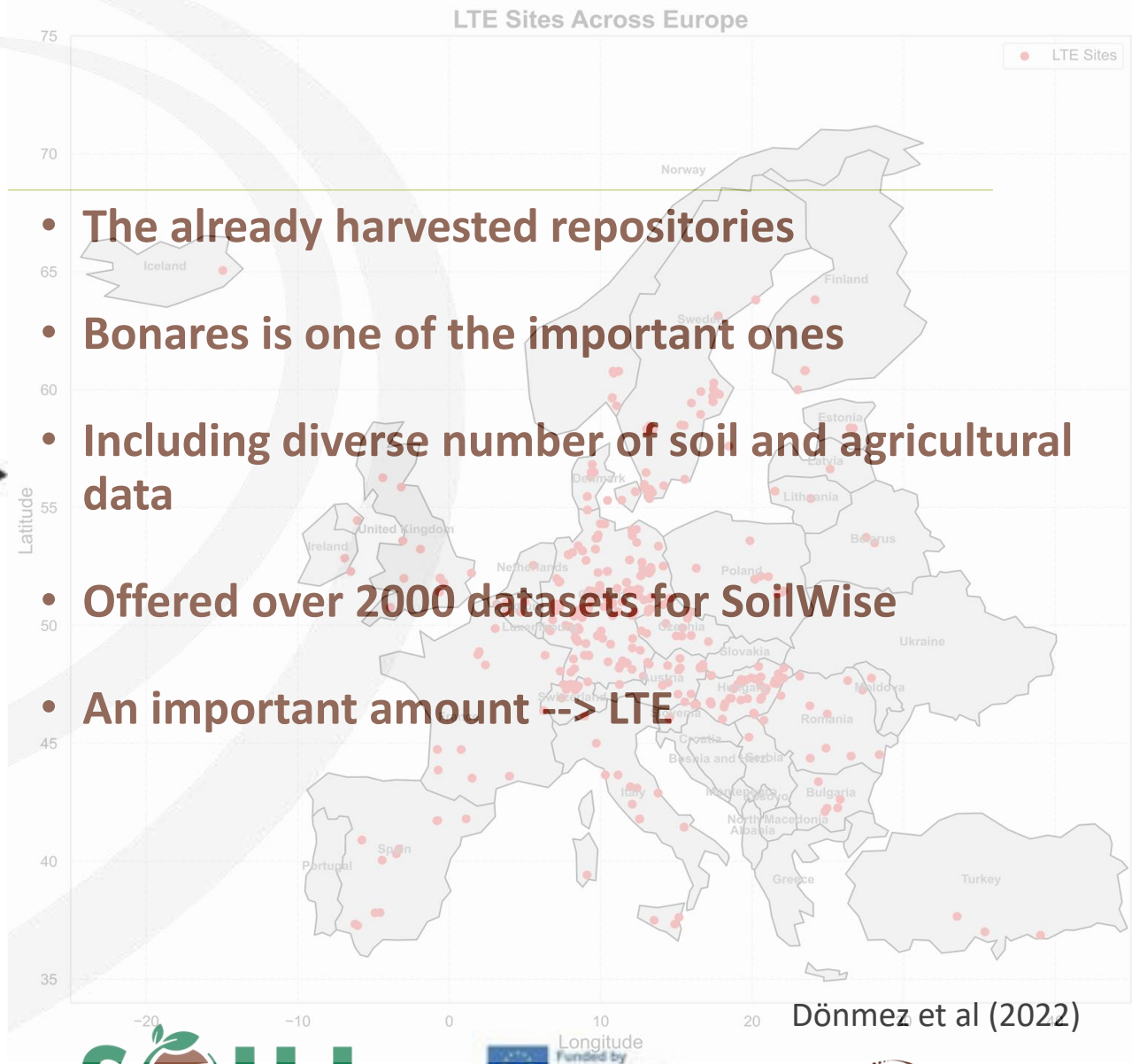
- Very diverse set of soil agricultural dataset
- Subjecting to different modeling and related analysis studies
- Important for soil and agricultural practices,
- Captured by different platforms, to be visible and reusable in the community

# Context & Importance


**Müncheberg**
https://doi.org/10.4228/zalf-xga4-xw15

**Großbeeren,**
https://doi.org/10.20387/bonares-fd75-nca9

- The already harvested repositories
- Bonares is one of the important ones
- Including diverse number of soil and agricultural data
- Offered over 2000 datasets for SoilWise
- An important amount --> LTE




Dönmez et al (2022)

This project has received funding from the Horizon Europe research and innovation programme under Grant Agreement No 101112838

# Use Case Overview

Three use case study example using the data from Soilwise

1. Data Article
   - Donmez et al (2022)
     Donmez, C., Blanchy, G., Svoboda, N., d'Hose, T., Hoffmann, C., Hierold, W., & Klumpp, K. (2022). Provision of metadata of European agricultural long-term experiments through BonaRes and EJP SOIL collaboration. Data in Brief, 42, 108226.
2. GIS based modelling paper
   - Dönmez et al (2023)
     Donmez, C., Schmidt, M., Cilek, A., Grosse, M., Paul, C., Hierold, W., & Helming, K. (2023). Climate change impacts on long-term field experiments in Germany. *Agricultural Systems*, *205*, 103578.
3. Biogeochemical modelling paper
   - Dönmez et al (2024)
     Donmez, C., Sahingoz, M., Paul, C., Cilek, A., Hoffmann, C., Berberoglu, S., ... & Helming, K. (2024). **Climate change** causes spatial shifts in the productivity of agricultural long-term field experiments. European Journal of Agronomy, 155, 127121.

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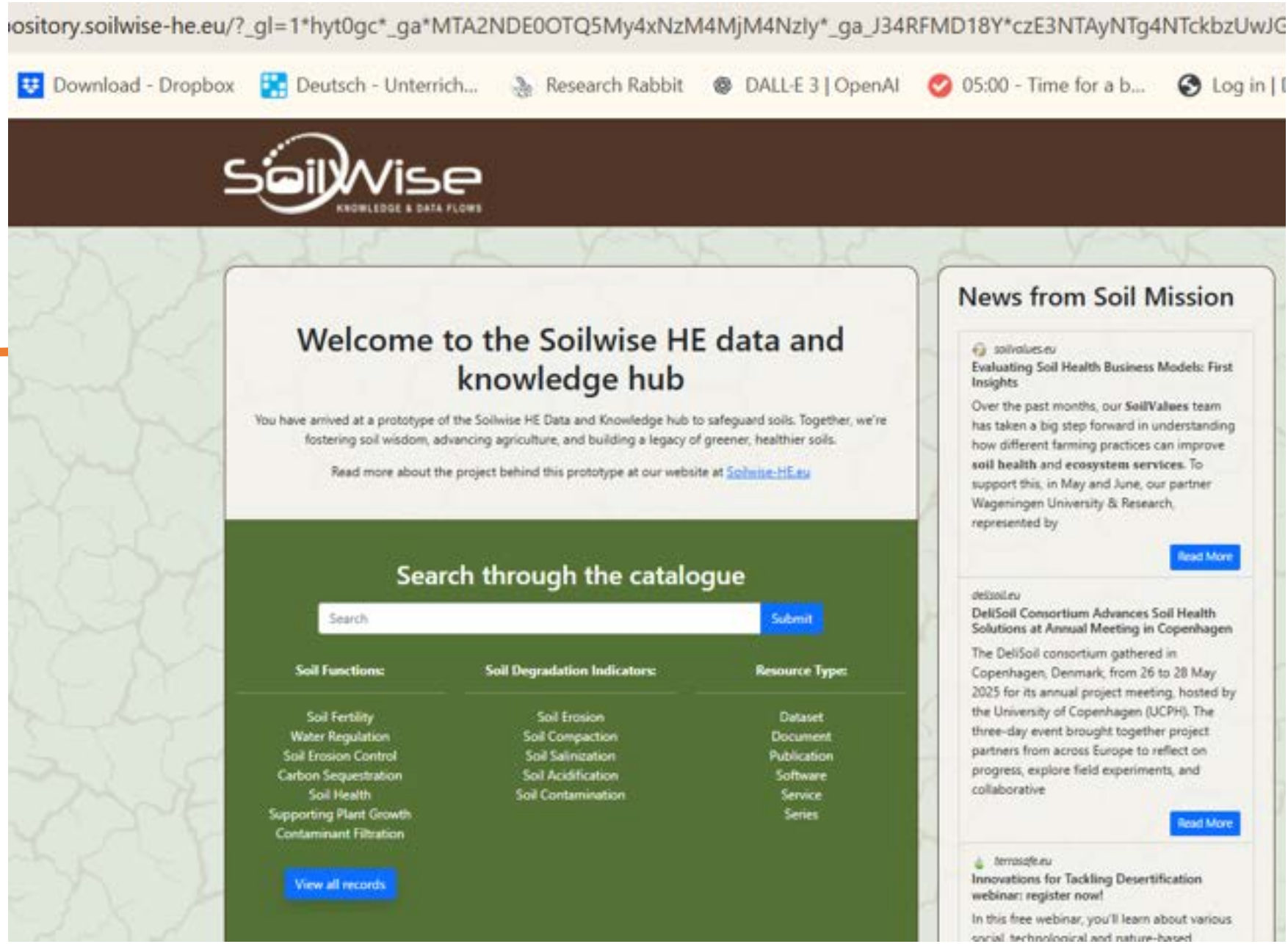
SoilWise KNOWLEDGE & DATA FLOWS

# Live-like Walkthrough

1. SoilWise catalogue

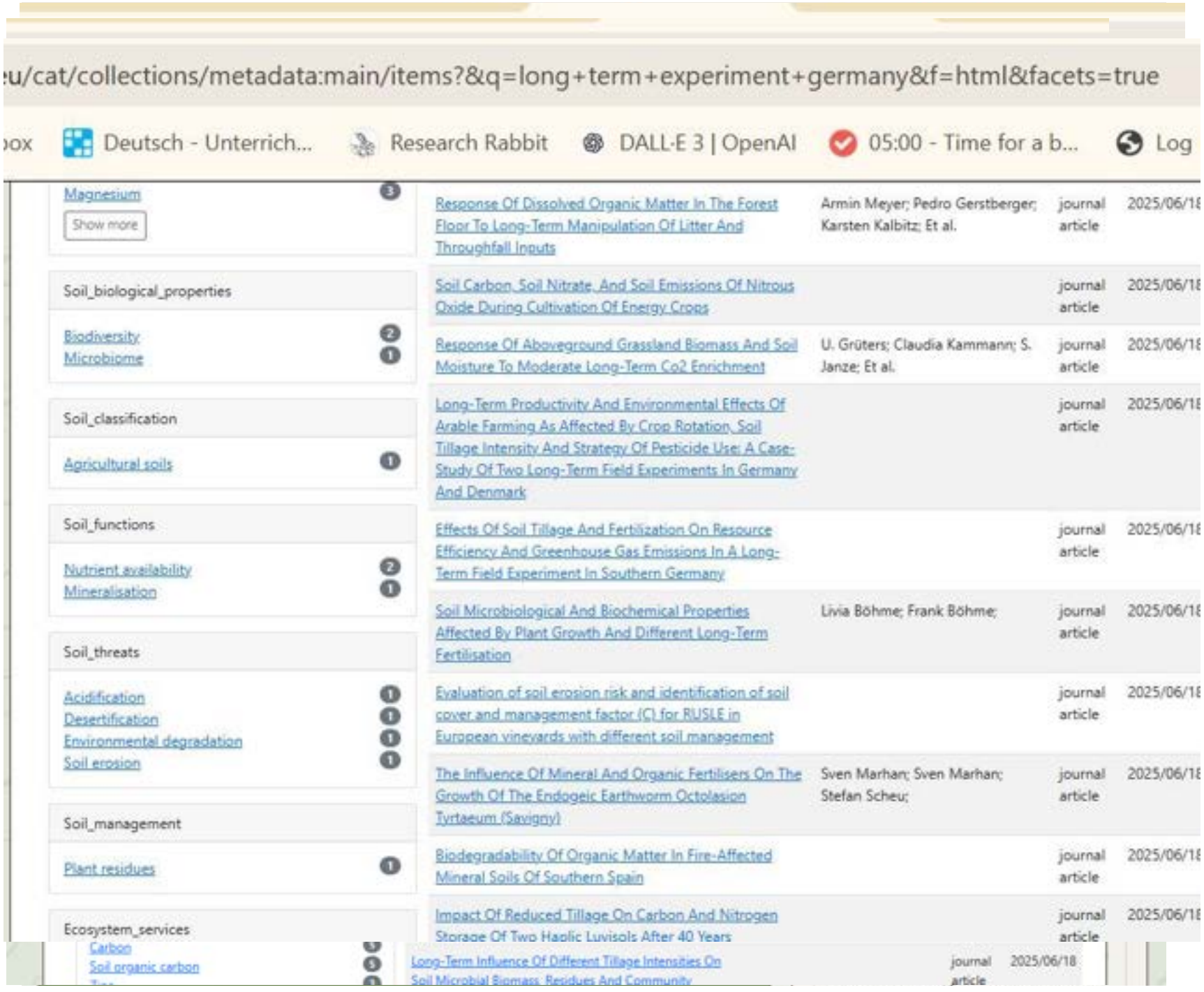


# Live-like Walkthrough

2. Long term experiment Germany

3. Spatial filter

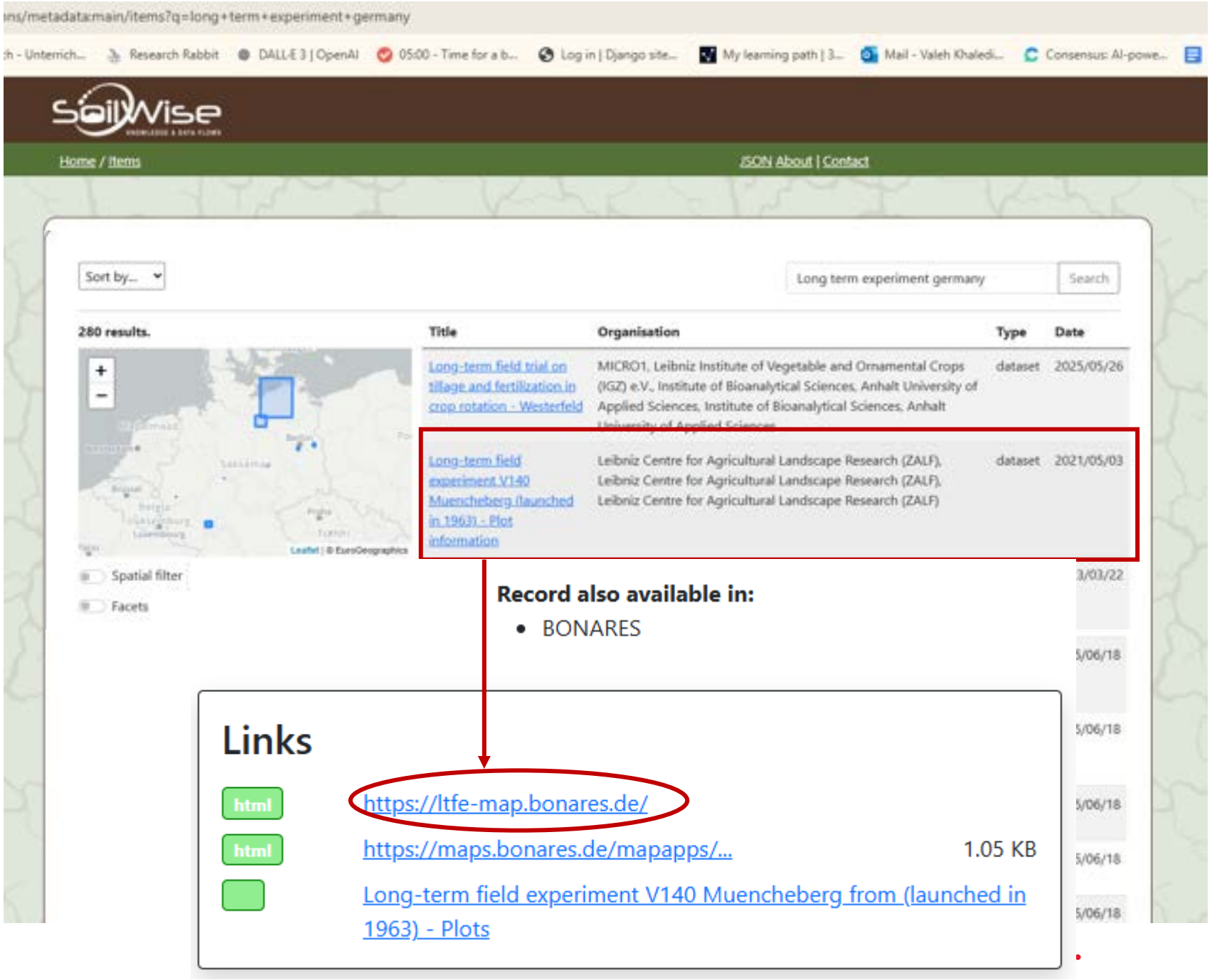
4. Facet option

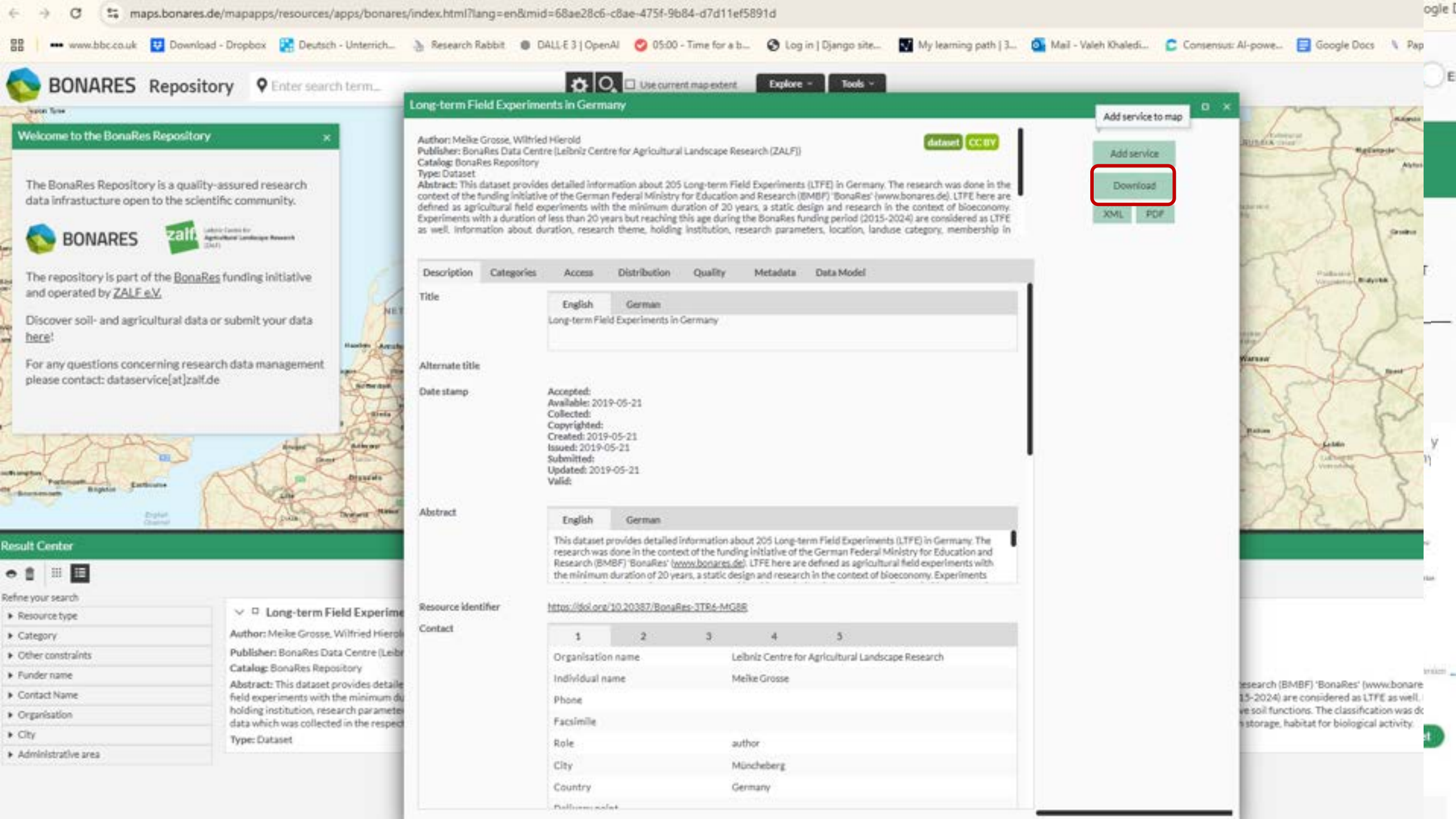


# Live-like Walkthrough

5. Long term experiment

6. BonaRes long term field experiment LTFE




maps.bonares.de/mapapps/resources/apps/bonares/index.html?lang=en&mid=68ae28c6-c8ae-475f-9b84-d7d11ef5891d
BONARES Repository
Enter search term...
Use current map extent
Explore
Tools
Welcome to the BonaRes Repository
The BonaRes Repository is a quality-assured research data infrastucture open to the scientific community.
BONARES
zalf
The repository is part of the BonaRes funding initiative and operated by ZALF e.V.
Discover soil- and agricultural data or submit your data here!
For any questions concerning research data management please contact: dataservice[at]zalf.de
Long-term Field Experiments in Germany
Author: Meike Grosse, Wilfried Hierold
Publisher: BonaRes Data Centre (Leibniz Centre for Agricultural Landscape Research (ZALF))
Catalog: BonaRes Repository
Type: Dataset
Abstract: This dataset provides detailed information about 205 Long-term Field Experiments (LTFE) in Germany. The research was done in the context of the funding initiative of the German Federal Ministry for Education and Research (BMBF) 'BonaRes' (www.bonares.de). LTFE here are defined as agricultural field experiments with the minimum duration of 20 years, a static design and research in the context of bioeconomy. Experiments with a duration of less than 20 years but reaching this age during the BonaRes funding period (2015-2024) are considered as LTFE as well. Information about duration, research theme, holding institution, research parameters, location, landuse category, membership in
dataset
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Quality
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Data Model
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German
Long-term Field Experiments in Germany
Alternate title
Date stamp
Accepted:
Available: 2019-05-21
Collected:
Copyrighted:
Created: 2019-05-21
Issued: 2019-05-21
Submitted:
Updated: 2019-05-21
Valid:
Abstract
English
German
This dataset provides detailed information about 205 Long-term Field Experiments (LTFE) in Germany. The research was done in the context of the funding initiative of the German Federal Ministry for Education and Research (BMBF) 'BonaRes' (www.bonares.de). LTFE here are defined as agricultural field experiments with the minimum duration of 20 years, a static design and research in the context of bioeconomy. Experiments
Resource identifier
https://doi.org/10.20387/BonaRes-3TP4-MG8R
Contact
1
2
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Organisation name
Leibniz Centre for Agricultural Landscape Research
Individual name
Meike Grosse
Phone
Facsimile
Role
author
City
Müncheberg
Country
Germany
Result Center
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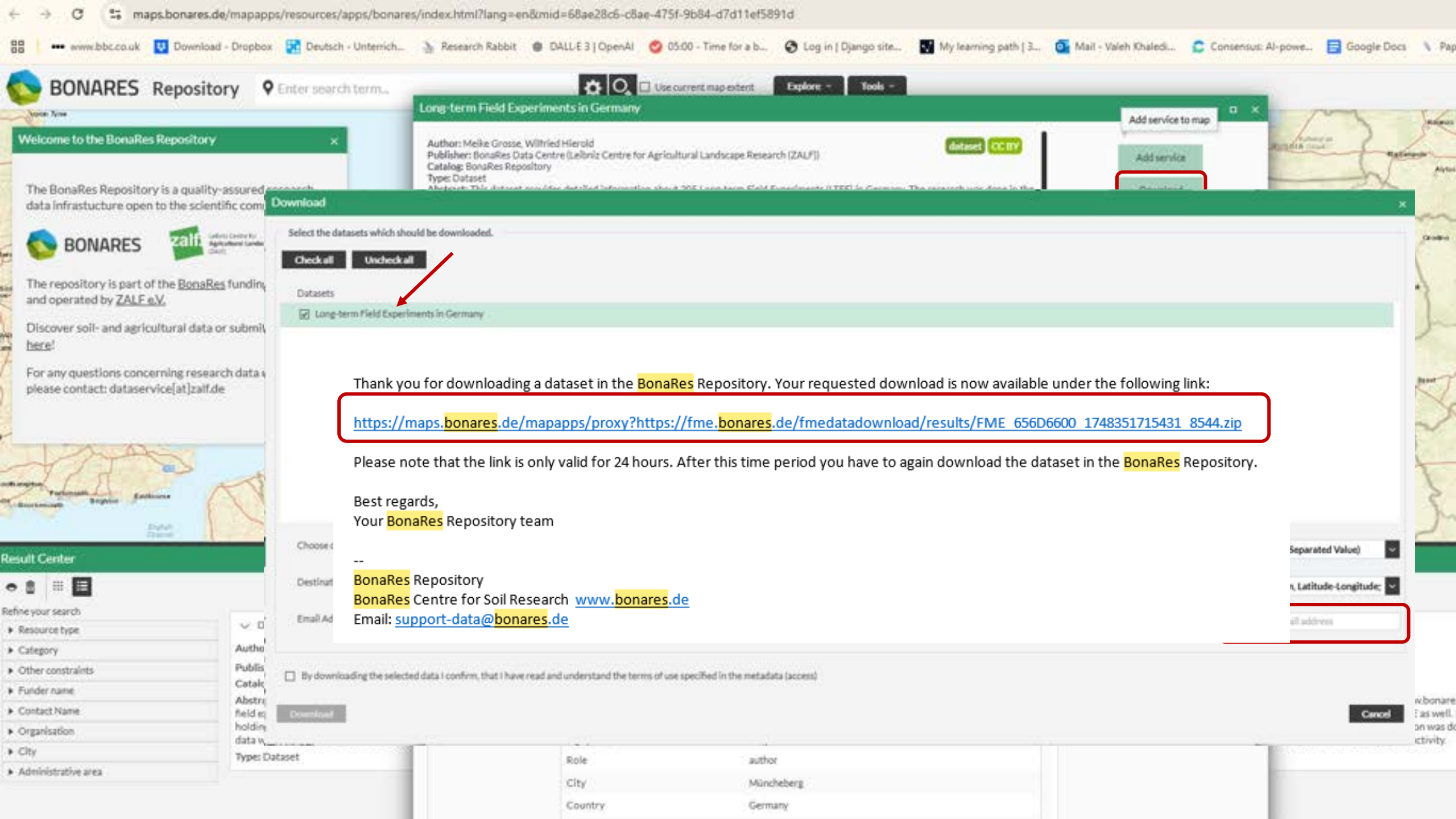
Long-term Field Experime
Author: Meike Grosse, Wilfried Hierol
Publisher: BonaRes Data Centre (Leibr
Catalog: BonaRes Repository
Abstract: This dataset provides detaile
field experiments with the minimum du
holding institution, research parameter
data which was collected in the respect
Type: Dataset


BONARES Repository
Welcome to the BonaRes Repository
Long-term Field Experiments in Germany
Download
Select the datasets which should be downloaded.
Check all
Uncheck all
Datasets
Long-term Field Experiments in Germany
Thank you for downloading a dataset in the BonaRes Repository. Your requested download is now available under the following link:
https://maps.bonares.de/mapapps/proxy?https://fme.bonares.de/fmedatadownload/results/FME_656D6600_1748351715431_8544.zip
Please note that the link is only valid for 24 hours. After this time period you have to again download the dataset in the BonaRes Repository.
Best regards,
Your BonaRes Repository team
--
BonaRes Repository
BonaRes Centre for Soil Research www.bonares.de
Email: support-data@bonares.de
By downloading the selected data I confirm, that I have read and understand the terms of use specified in the metadata (access)
Cancel
Result Center
Refine your search
Resource type
Category
Other constraints
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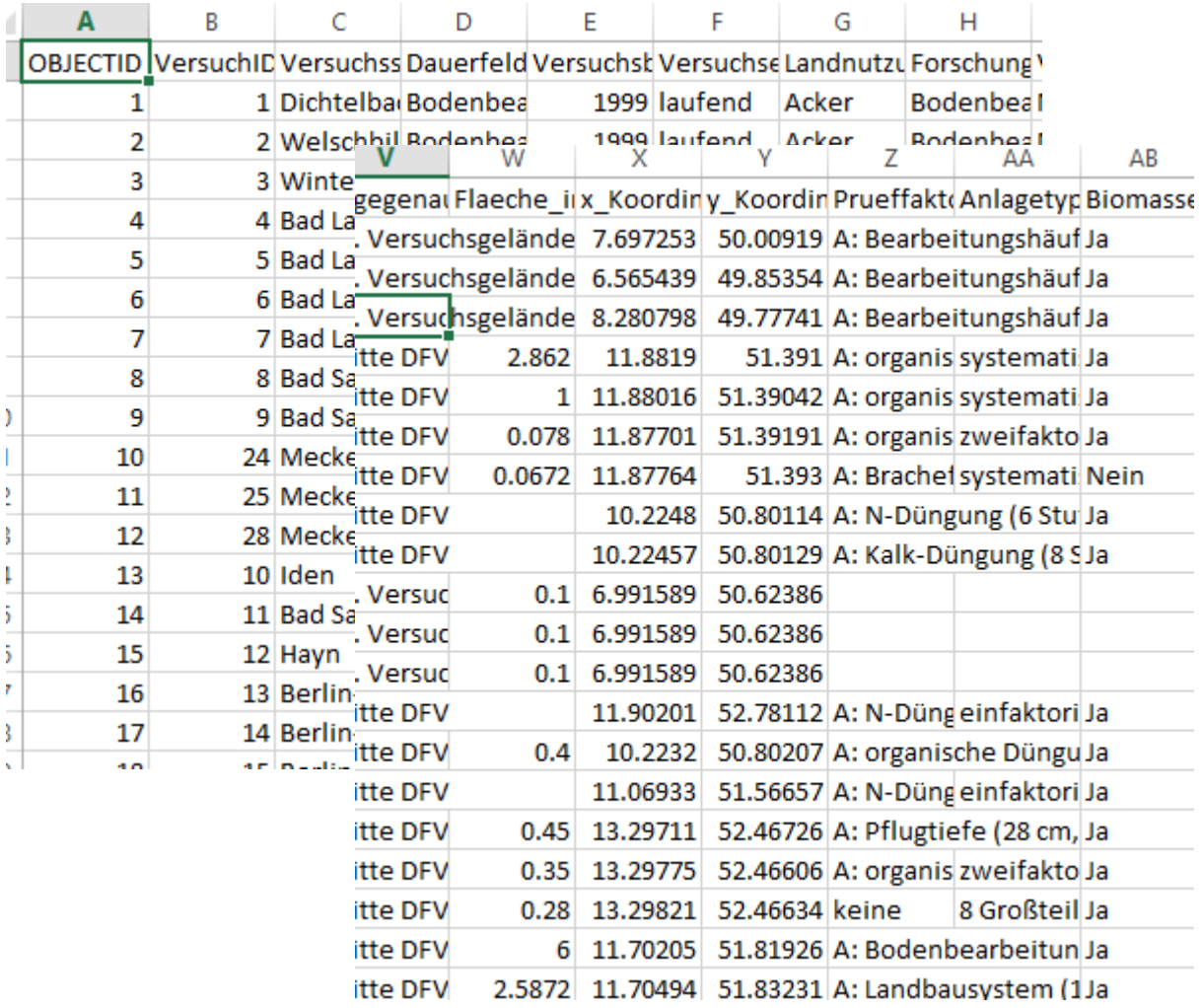
Contact Name
Organisation
City
Administrative area
Role
author
City
Müncheberg
Country
Germany

# Live-like Walkthrough

- Material findable in csv
- Accessibility of further details through websites/ paper
- Climate data can be obtained via the lat/lon info (worldclim)



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| 12 | 28 | Mecke | | | | | |
| 13 | 10 | Iden | | | | | |
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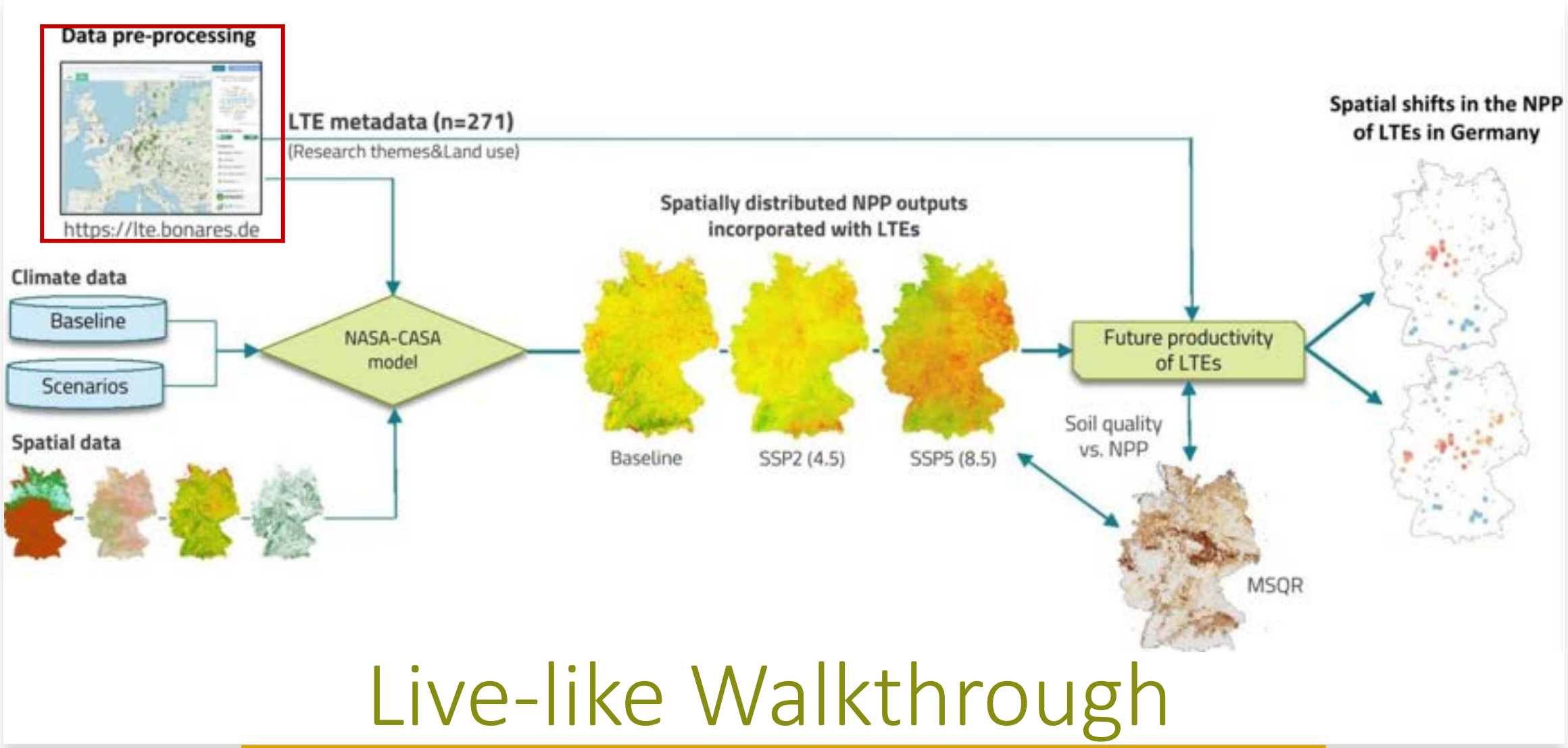
| . Versuchsgelände | | 7.697253 | 50.00919 | A: Bearbeitungshäuf | | Ja |
| . Versuchsgelände | | 6.565439 | 49.85354 | A: Bearbeitungshäuf | | Ja |
| . Versuchsgelände | | 8.280798 | 49.77741 | A: Bearbeitungshäuf | | Ja |
| itte DFV | 2.862 | 11.8819 | 51.391 | A: organis | systemati | Ja |
| itte DFV | 1 | 11.88016 | 51.39042 | A: organis | systemati | Ja |
| itte DFV | 0.078 | 11.87701 | 51.39191 | A: organis | zweifakto | Ja |
| itte DFV | 0.0672 | 11.87764 | 51.393 | A: Brachel | systemati | Nein |
| itte DFV | | 10.2248 | 50.80114 | A: N-Düngung (6 Stu | | Ja |
| itte DFV | | 10.22457 | 50.80129 | A: Kalk-Düngung (8 S | | Ja |
| . Versuc | 0.1 | 6.991589 | 50.62386 | | | |
| . Versuc | 0.1 | 6.991589 | 50.62386 | | | |
| . Versuc | 0.1 | 6.991589 | 50.62386 | | | |
| itte DFV | | 11.90201 | 52.78112 | A: N-Düng | einfaktori | Ja |
| itte DFV | 0.4 | 10.2232 | 50.80207 | A: organische Düngu | | Ja |
| itte DFV | | 11.06933 | 51.56657 | A: N-Düng | einfaktori | Ja |
| itte DFV | 0.45 | 13.29711 | 52.46726 | A: Pflugtiefe (28 cm, | | Ja |
| itte DFV | 0.35 | 13.29775 | 52.46606 | A: organis | zweifakto | Ja |
| itte DFV | 0.28 | 13.29821 | 52.46634 | keine | 8 Großteil | Ja |
| itte DFV | 6 | 11.70205 | 51.81926 | A: Bodenbearbeitun | | Ja |
| itte DFV | 2.5872 | 11.70494 | 51.83231 | A: Landbausystem (1 | | Ja |




# Live-like Walkthrough

Dönmez et al (2024)

# Live-like Walkthrough

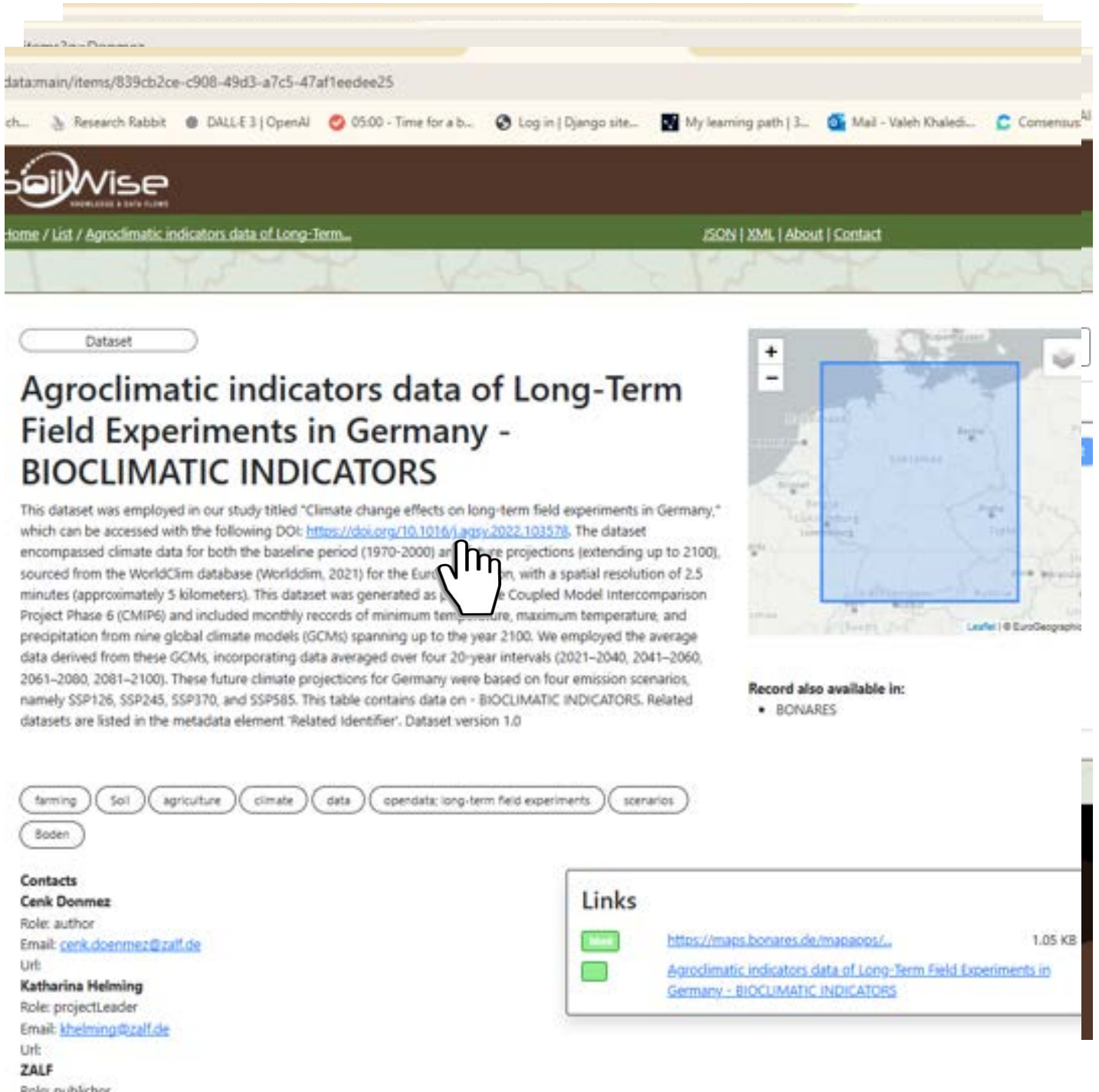
- Metadata of 271 LTEs made publicly available through the LTE overview
- Data on research
  - Theme (1)
  - Land use (2)
  - Farming category (3)
  - Duration (4).

LTE metadata structure used for NPP modelling in this study.

| Experiment | Research theme | Land use | Farming category |
|---|---|---|---|
| • Experiment ID<br>• Experiment name<br>• Latitude<br>• Longitude<br>• Location<br>• Plot size | • Fertilization<br>• Tillage<br>• Crop rotation<br>• Fertilization/ Crop rotation<br>• Tillage/ Crop rotation | • Arable land<br>• Grassland<br>• Other, e.g., agroforestry, orchards) | • Conventional<br>• Organic<br>• Conventional and Organic |

# Live-like Walkthrough

Findability of knowledge produced through data from SoilWise Repository!



# Live-like Walkthrough

**Findability** of knowledge produced through data from SoilWise Repository!

# Wrap-Up & Takeaway

- **SoilWise** is a practical entry point to access and explore data from multiple repositories, including **BonaRes**
- The LTE dataset shown is **one example** — similar workflows can be applied to other data sources across the platform
- This demonstrates how **rich, well-structured datasets** can support advanced modeling and knowledge generation
- Stakeholders engagement is significant for feedback as is a dynamic platform

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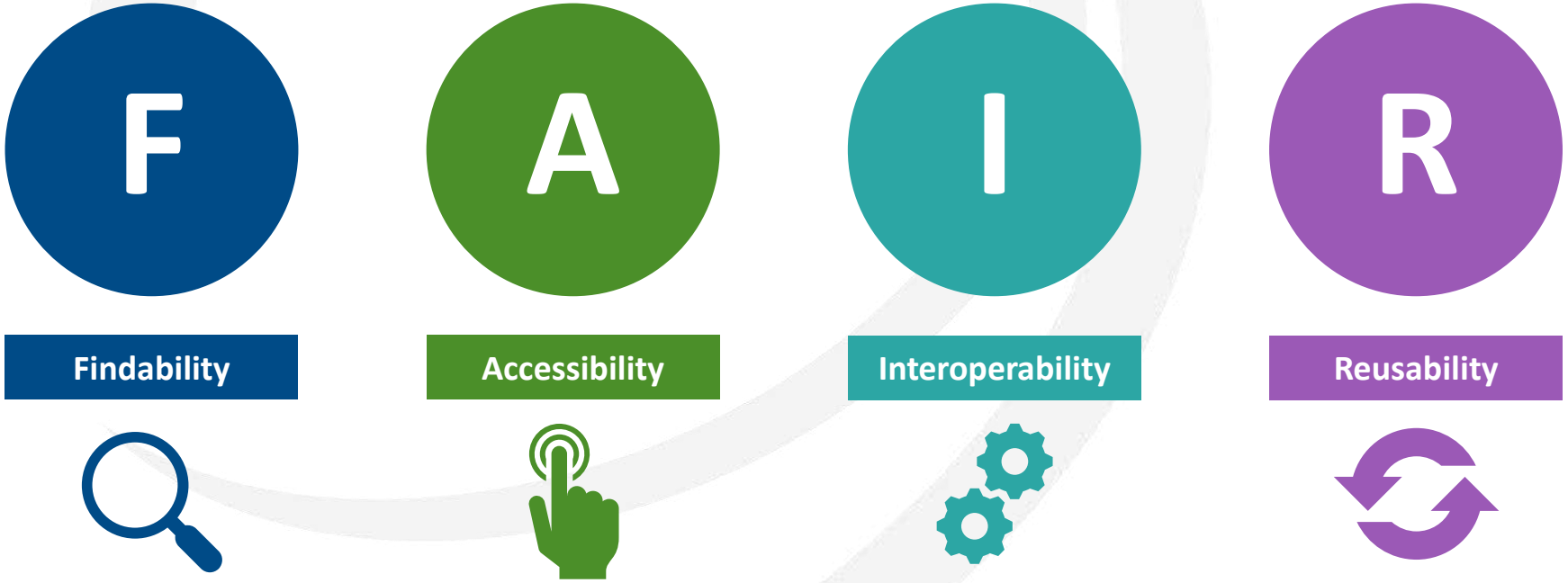
SoilWise KNOWLEDGE & DATA FLOWS

# Strategy on publishing FAIR data and knowledge

**Tomáš Pavelka - Masaryk University**




**FAIR is not just about storing data. It’s about making sure what we’ve created can live on.**

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F

**Findability**

Easy to find for both humans and machines, using **unique identifiers** and **rich metadata**.

**SWR Harvested Repositories:**

- INSPIRE geoportal
- CORDIS
- ESDAC
- Bonares
- EJP Soil
- PrepSoil
- Impact4Soil
- FAO Soils portal
- EEA Datahub
- ISRIC - World Soil Information

Select a trustworthy (persistent) repository

- E.g. at re3data.org
- In case of Zenodo, create also Zenodo Community

Fill all metadata possible

- Use Persistent Identification (DOI)

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# A

**Accessibility**

Once found, assets should be retrievable through **standardized and open protocols**, with clear **access conditions**.

restricted

registration needed

no conditions apply

**FAIR Data**
**≠**
**Open data**

- **Try to be as open as possible; as closed as necessary**
- Access via standard protocol (HTTP), REST API, web services, GitHub, …
- Metadata and data might have different access conditions
  - E.g. Metadata and a summary are public, but actual data access requires a request through a contact form.

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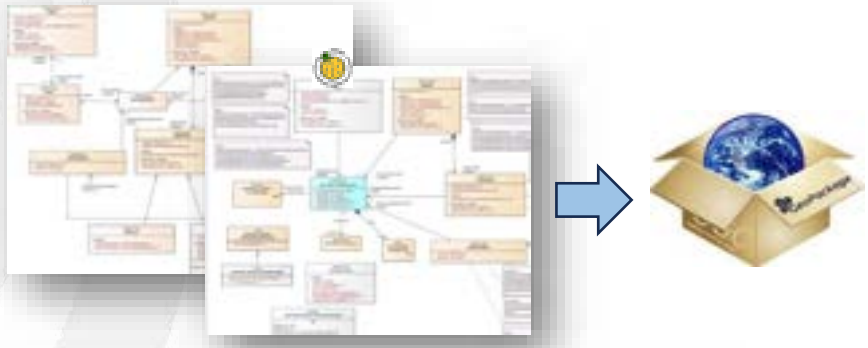
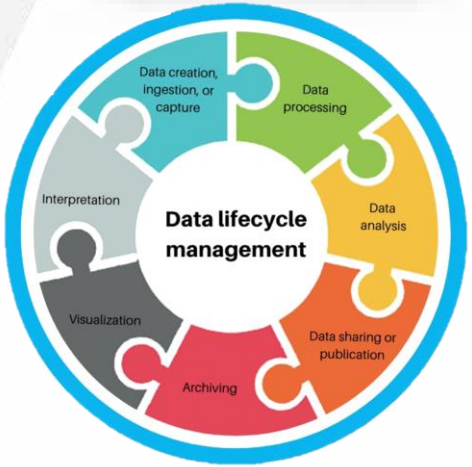
I

**Interoperability**

Use **standardised formats**, **vocabularies**, and **ontologies** so it can be integrated with other data and tools.



- Think about the whole data lifecycle
  - E.g. when you want your O&M data will be automatically harvested and processed
- Don‘t use proprietary formats
  - CSV instead of Excel, GeoJSON instead of shapefile, PDF instead of docx
- Use standardised vocabulary if possible
  - E.g. AGROVOC, GEMET, INSPIRE themes, …




Data lifecycle diagram

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R

**Reusability**

**Well-described**, **licensed**, and **structured** to allow future reuse in different contexts and by different users.

Completeness

CC-BY 4.0 license

Duplicates

Empty fields

Broken links

Context derived additional metadata

- Use standardised licences, such as Creative Commons (cc-by-4.0, cc0)
- Indicate also e.g. methodology, software version, processing scripts, and details about accuracy and limitations.

**FAIR Data ≠ Open data**

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# Metadata Management

**Metadata play a central role in this process: without clear and rich metadata, data and knowledge cannot be truly findable or reusable.**

- Inventory & Typology
  - Identify what data and knowledge will be created or reused.
  - Classify them by type, format, origin, and reuse potential.
  - Remember that the goal is to sustain the assets persistently. It doesn't need to cover only the obvious data, but also other knowledge, website, etc.
- Define what metadata are needed to describe the content, origin, context, quality, and terms of use of your data or knowledge assets.
  - Select the **trustworthy repository** accordingly. Remember to use **persistent identification**.
- Note that, in most cases, you can create metadata directly in the repository during the resource upload.

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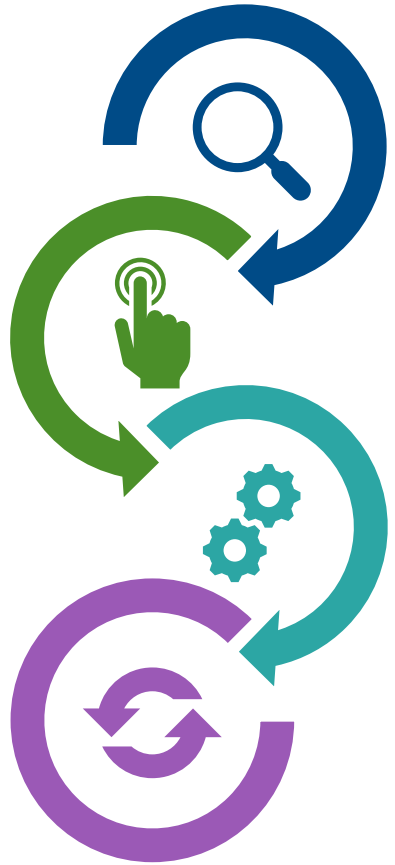
# FAIR Benefits

- **Transparency** – allowing others to understand how data were produced and under what conditions.
- **Collaboration** – making it easier to combine datasets across projects, regions, and domains.
- **Efficiency** – reducing duplication of efforts and enabling the reuse of existing data.
- **Impact** – enhancing the potential for innovation, decision support, and long-term use of project outputs.



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# Tips & Tricks

**Max Vercruyssen – Flemish Government**

# Useful links

- Guides
  - OpenAIRE,
  - go-fair.org.
- Tools to test your resource FAIRness
  - FAIR Data Self-Assessment,
  - FAIRsFAIR.
- Official Horizon 2020 documents
  - Guidelines on FAIR Data Management in Horizon 2020,
  - Guidelines to the Rules on Open Access to Scientific Publications and Open Access to Research Data in Horizon 2020.
- Manual on data upload to Zenodo

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# Useful tools

- Transformation
  - Hale Studio
  - Hale Studio – Training; tansformation to INSPIRE
- Vocabularies
  - OpenRefine
  - Annif
- Inspire Geopackage
  - Github
  - Youtube trainings

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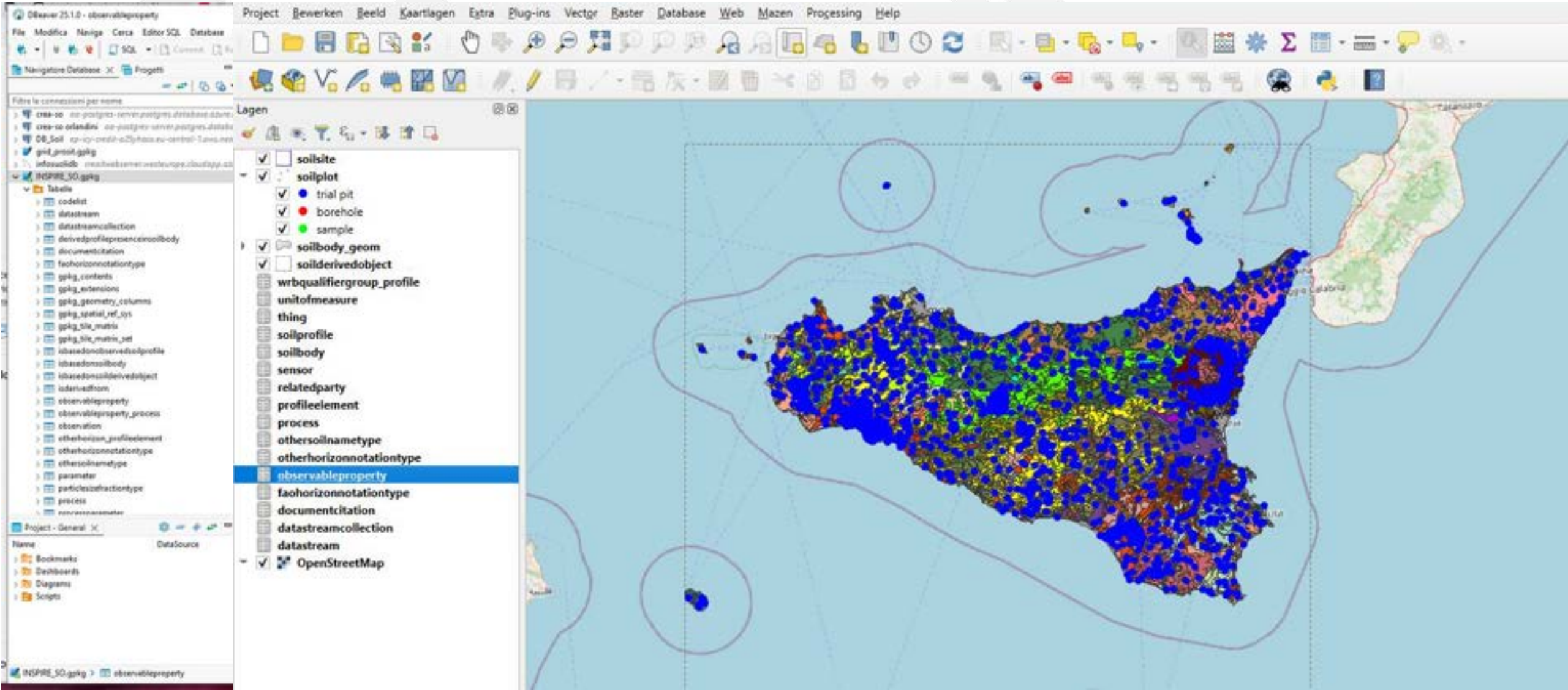
# Inspire Geopackage



# Report – Human readable

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# Report – ‘soil scientist’ readable


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# Report – machine readable

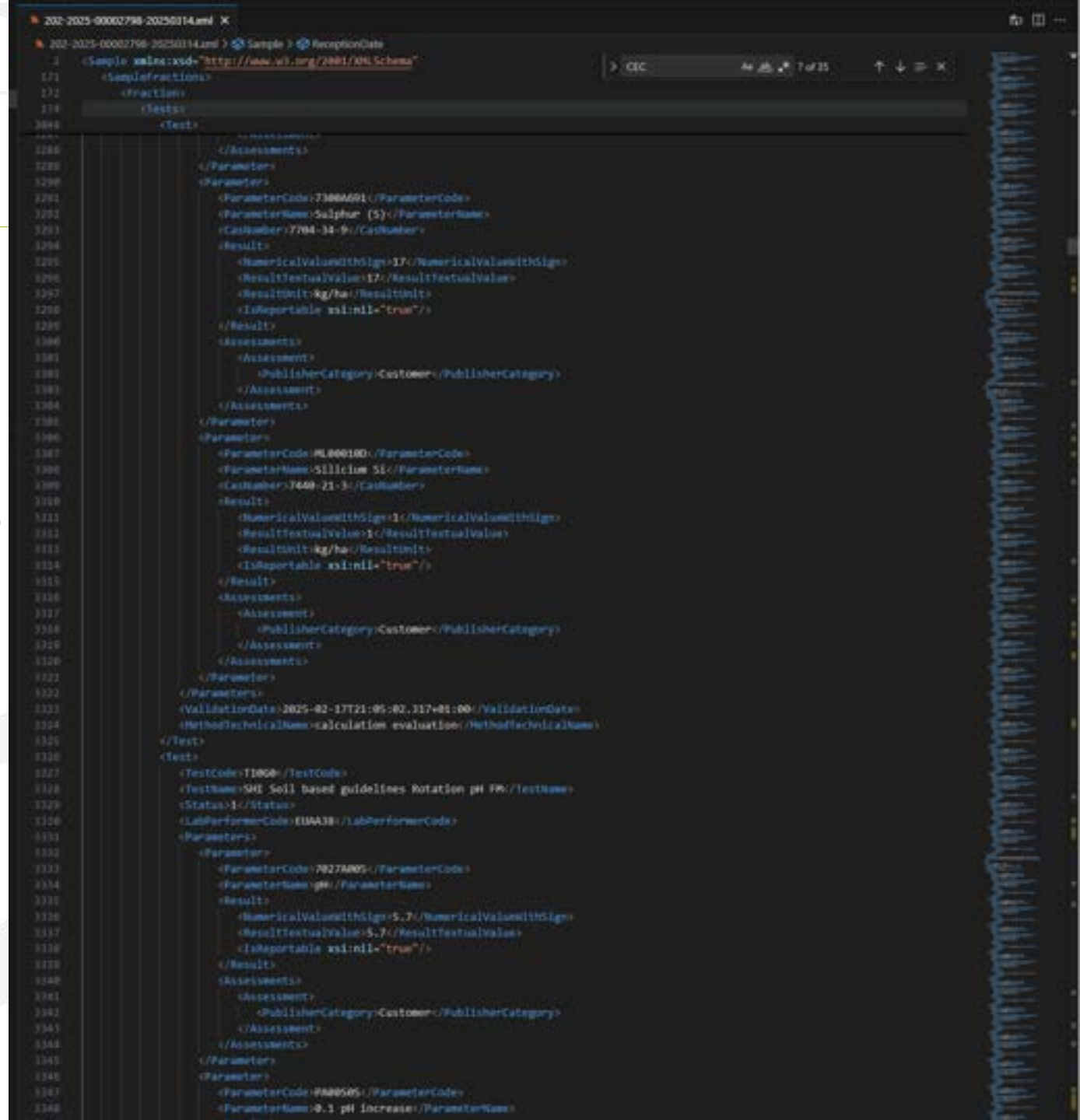
```
<ParameterName>Sulphur (S)</ParameterName>
<CasNumber>7704-34-9</CasNumber>
```

Adding also a more specific codelist:
Ex. Glosis
**http://w3id.org/glosis/model/codelists/physioChemicalPropertyCode-Sulext**
“Sulfur bound to the soil matrix but that can be released into the soil solution (i.e. become bio-available)”

```
<ResultUnit>kg/ha</ResultUnit>
```

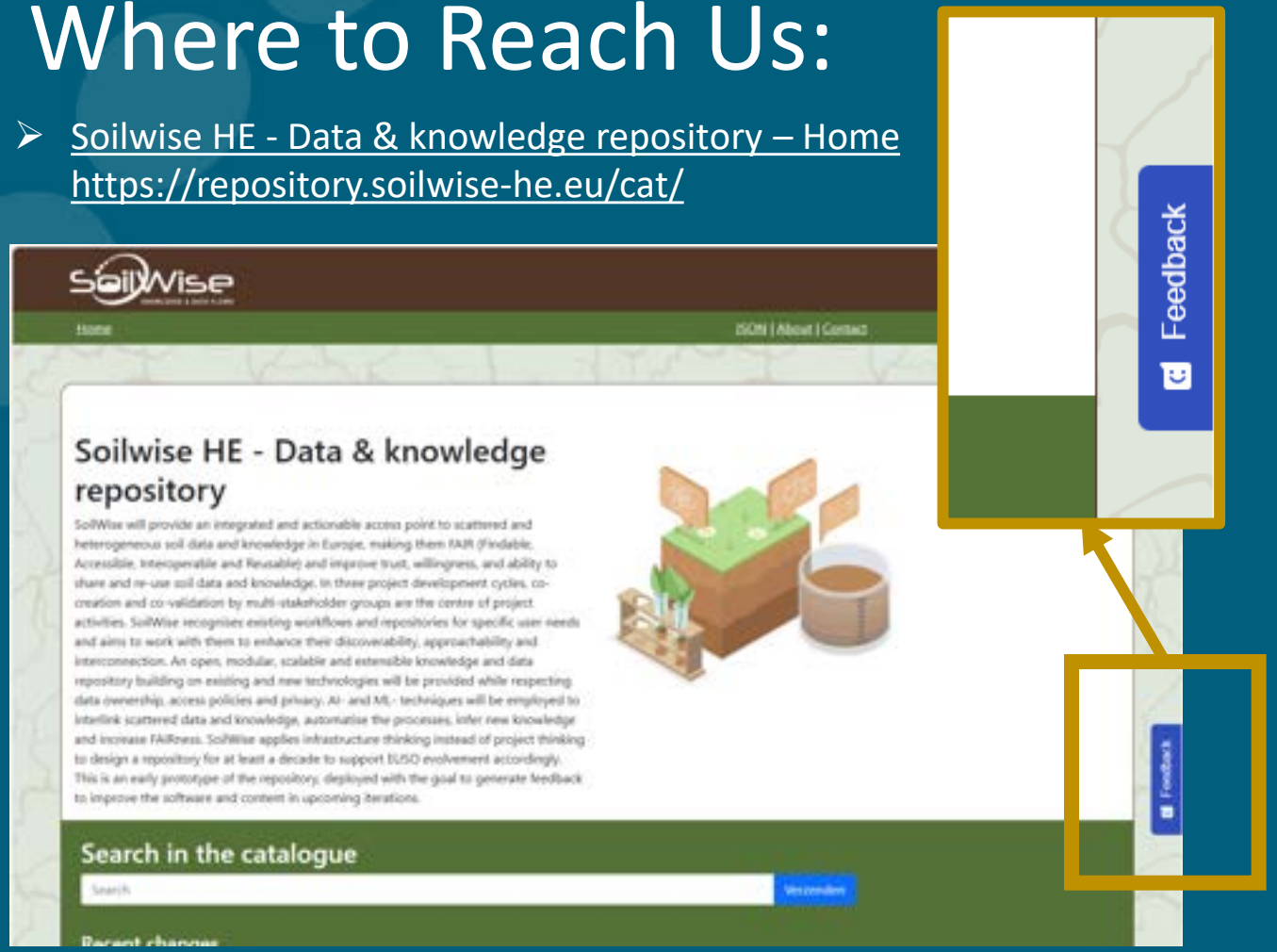
```
<MethodTechnicalName>calculation evaluation</Me
```

Adding also external procedure references:
- ISO or NEN; “EN 16171:2017”
- Glosis



# Where to Reach Us:

- Soilwise HE - Data & knowledge repository – Home
  https://repository.soilwise-he.eu/cat/

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