MUNI | RECETOX

Soil Health BENCHMARKS

Jakub Hofman

https://soilhealthbenchmarks.eu/

BENCHMARKS
Building a European network to advance soil research, monitor soil health and advocate for sustainable land use

Horizon Europe Framework Programme (HORIZON)

Call: Research and Innovation and other actions to support the implementation of a mission in the area of Soil health and Food (HORIZON-MISS-2021-SOIL-02)

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

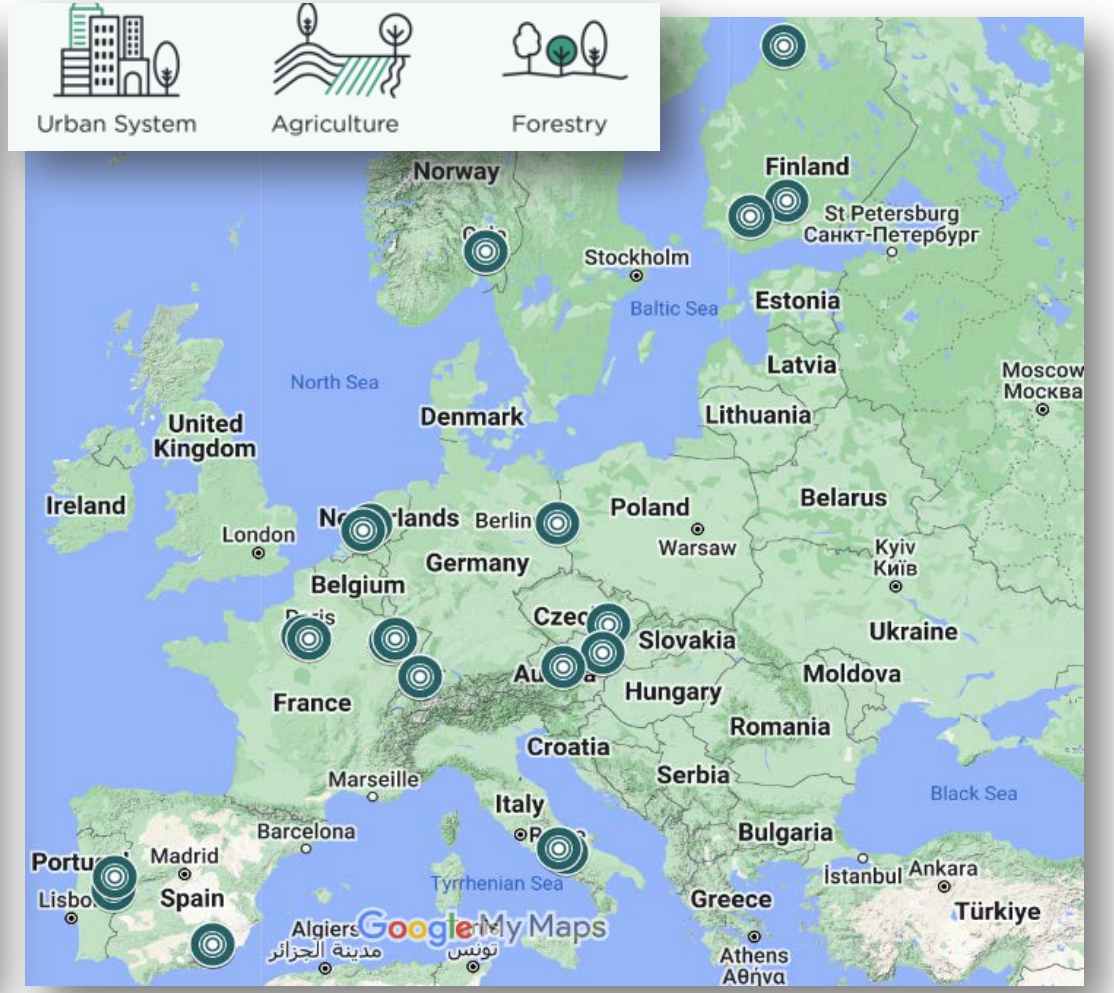
Type of Action: HORIZON-RIA

Coordinator: prof. Creamer, WU; **Grant Number:** 101091010; **Timeline:** 1/1/2023 – 31/12/2027

BENCHMARKS objectives

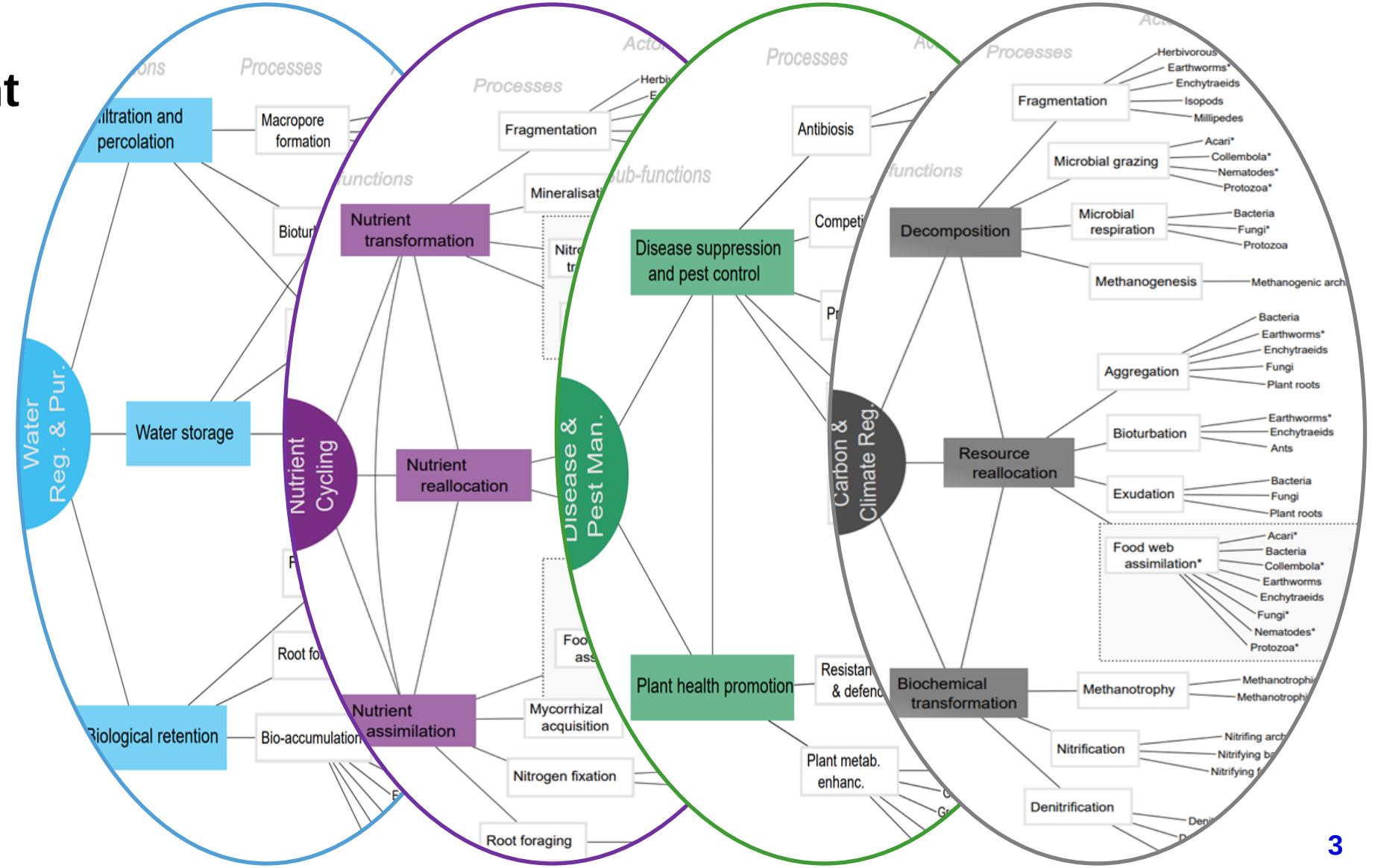
- develop **Integrated Soil Health Monitoring Framework** with **stakeholders** from **24 Living Labs** across Europe and 3 ecosystems

No.	Country	Partner	Regional	Landscape: ecosystem pair
1	Netherlands	WUR	Flevoland	Agriculture - Urban
2	Netherlands	WUR/Commonland/Wij.land	Western peat meadow area	Agriculture - Urban
3	France	INRAE	Paris region	Agriculture - Urban
4	France	INRAE		Agriculture - Urban
5	France	INRAE	Nancy	Urban - Forest
6	France	INRAE		Agriculture - Forest
7	Portugal	UC	Central Region	Agriculture - Forest
8	Portugal	UC	Lynx land	Agriculture - Forest
9	Norway	NINA	Oslo	Urban - Forest
10	Norway	NINA	Oslo	Urban - Forest
11	Finland	LUKE	Lahti-Asikkala	Urban - Forest
12	Finland	LUKE	Ruuki	Agriculture - Forest
13	Finland	LUKE	Jokioinen	Agriculture - Forest
14	Czech	CzG and RECETOX	Brno region	Urban - Forest
15	Spain	CSIC/Junquera/Commonland	Alvelal territory	Agriculture - Forest
16	Spain	CSIC/Junquera/Commonland		Agriculture - Forest
17	Austria	Alfred Grand		Agriculture - Urban
18	Austria	AGES	Vienna	Agriculture - Urban
19	Austria	AGES (EAA)	LTER Zöbelboden Region	Agriculture - Forest
20	Switzerland	IAP and FIBL	Basel Region	Agriculture - Forest
21	Switzerland	IAP and FIBL		Agriculture - Forest
22	Italy	CNR/UNA	Campania Region	Agriculture - Forest
23	Italy	UNA/CNR	Metropolitan City of Naples	Agriculture - Urban
24	Germany	ZALF	Berlin Region	Agriculture - Urban



BENCHMARKS objectives

- **indicators for soil health assessment**
  - o harmonised
  - o cost-effective
  - o clear **links to soil functions and ecosystem services**



BENCHMARKS objectives

- test and validate the **SH&F mission indicators** as well as the **BENCHMARKS additional indicators** for the different land-uses and different scales

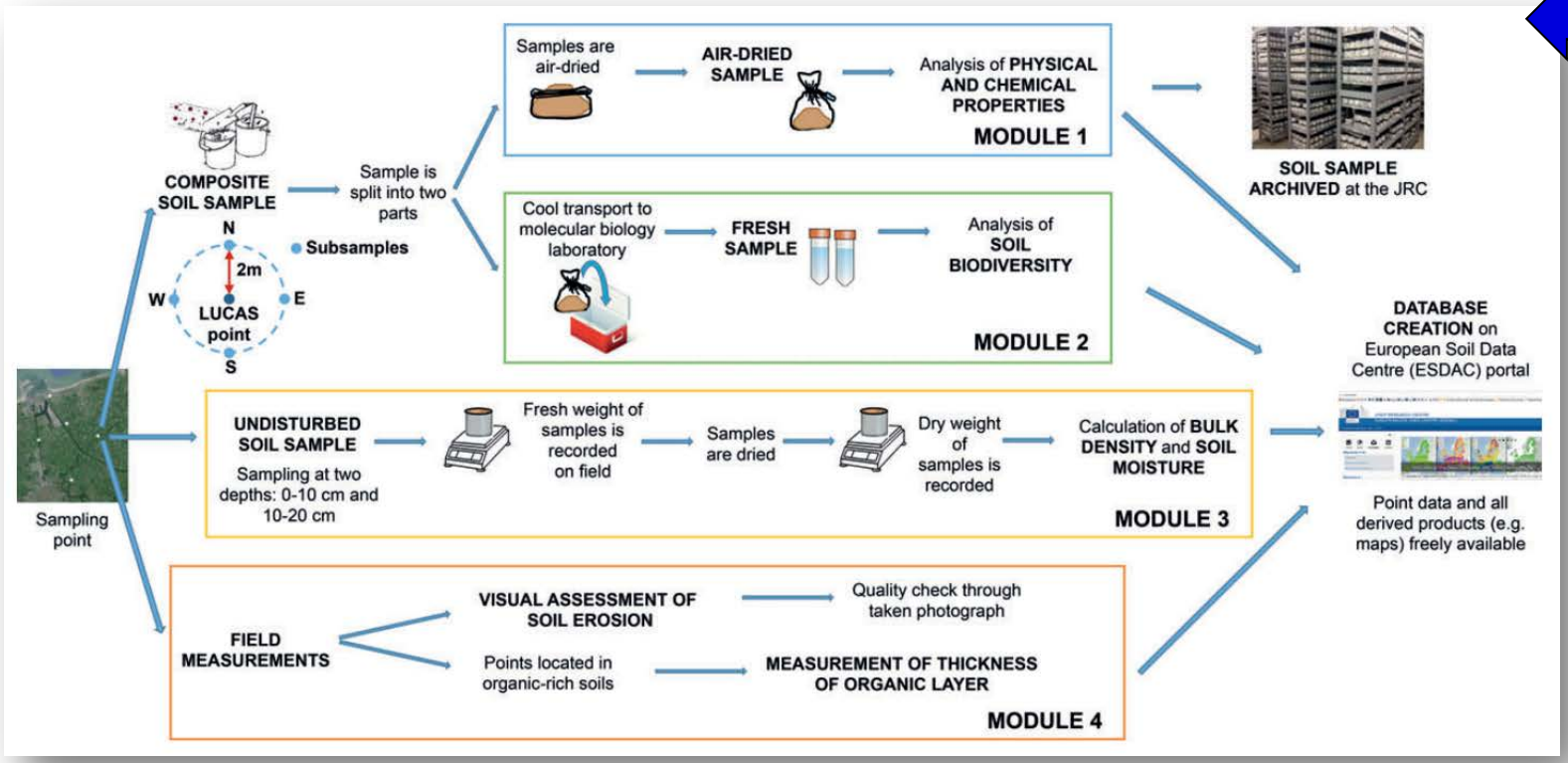
SH&F mission indicators		BENCHMARKS proposed additional indicators
1	Presence of pollutants, excess nutrients and salts	Microplastics, metals, trace elements, pesticides, organic contaminants
2	Soil organic carbon	Particulate Organic Matter:Mineral Associated Organic Matter, carbon aggregate fractions, HWEC, DOC, Rock-eval fractions SOC derived from Sentinel-2 Bare soil composite [existing soc maps, carbon sequestration via the century model)]
3	Soil structure, bulk density, absence of sealing and erosion	Texture, aggregate stability, infiltration rate, water holding capacity, moisture Water infiltration, surface soil moisture derived from Sentinel-1 coupled. Soil texture derived from Sentinel-2 Bare soil composite. Imperviousness Density (Copernicus Land Monitoring Service (CLMS)) [Erosion risk – PERSERA model]
4	Soil biodiversity: functional diversity of appropriate bacteria and fungi and of soil animal communities	Soil microbiological (bacteria, fungi and archaea) measurements (Metabarcoding, qPCR, 16S, ITS, 18S, PLFA), functional genes, mycorrhizal fungi. **Microfauna**: nematodes, protozoa, **Mesofauna:** acari, collembola, enchytraeids, **Macrofauna:** earthworms. Soil fauna will be considered using morphological and molecular methods where applicable. In a subset of sites; process based: enzymes, mineralisable N, biomass C, N, P, soil respiration (CO_2 flux).
5	Soil nutrients (N, P, K, S, Ca). Micro-nutrients (B, Cl, Co, Cu, Fe, Mn, Mo and Zn) and pH	NIR/MIR spectroscopy and wet chemistry methods will be compared where applicable. Soil salinity and pH proxies derived from Sentinel-2 Bare soil composite
6	Vegetation cover	Annual duration and diversity of vegetation cover and its net primary productivity, species diversity, forest structure, crop types and crop sequences, land management practices and intensity from Sentinel/hyperspectral airborne and commercial high-resolution multi-band images.
7	Landscape heterogeneity	Landscape configuration of landscape elements based on CLMS 'Very High-Resolution Image Mosaics' (1-4m); Land cover.
8	Area of forest and other wooded lands	Land cover and land cover change: CLMS Land cover and land cover changes; Species diversity; Nature (forest) recovery from droughts, fires and floods (Copernicus Emergency Management Service)

EC (2021): EU Mission Soil Deal for Europe: Implementation plan. https://research-and-innovation.ec.europa.eu/document/download/1517488e-767a-4f47-94a0-bd22197d18fa_en?filename=soil_mission_implementation_plan_final.pdf

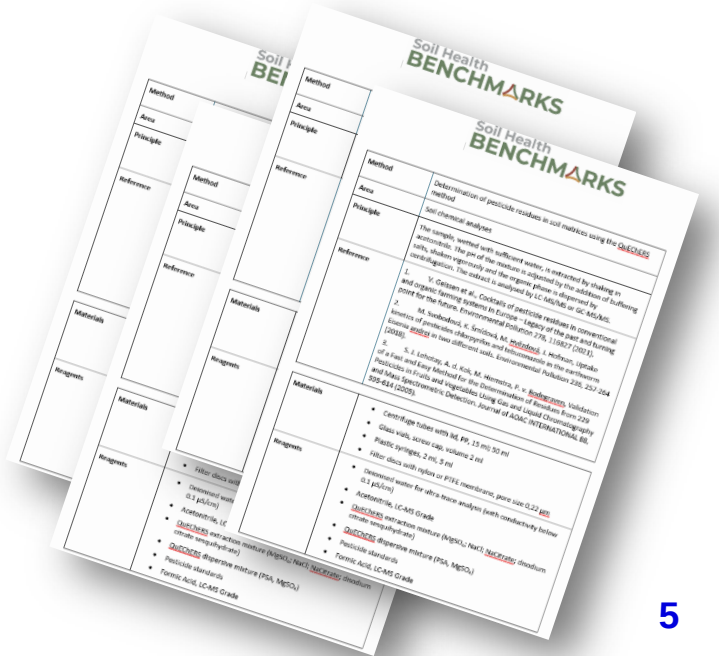
BENCHMARKS objectives

- develop a European broad **sampling framework, methodology and protocols**, which can support relevant EU policy, regulation and monitoring needs

LUCAS sampling methodology



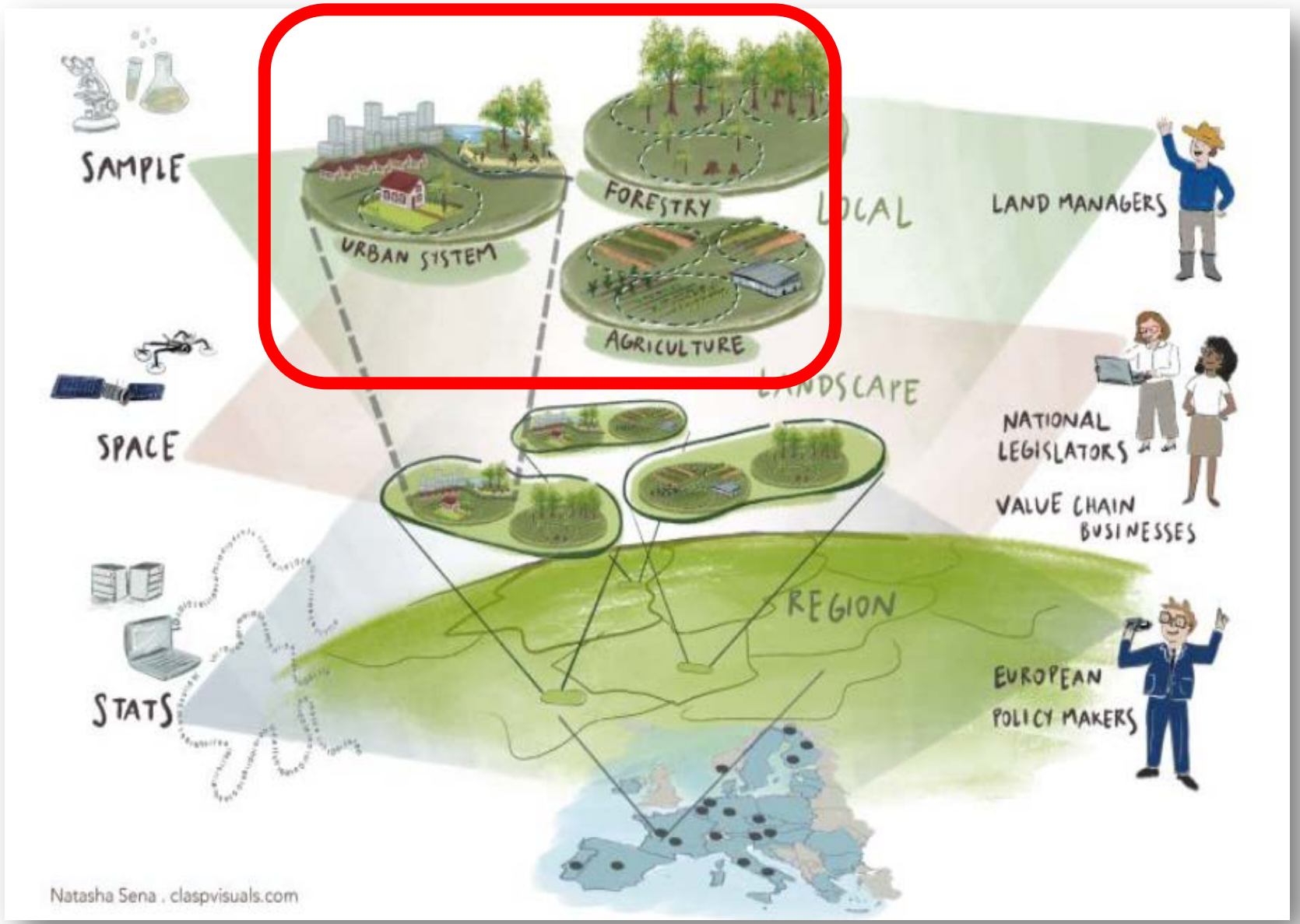
national methodologies specific for urban, agricultural, forest soils



BENCHMARKS concept

24 case studies (living labs)

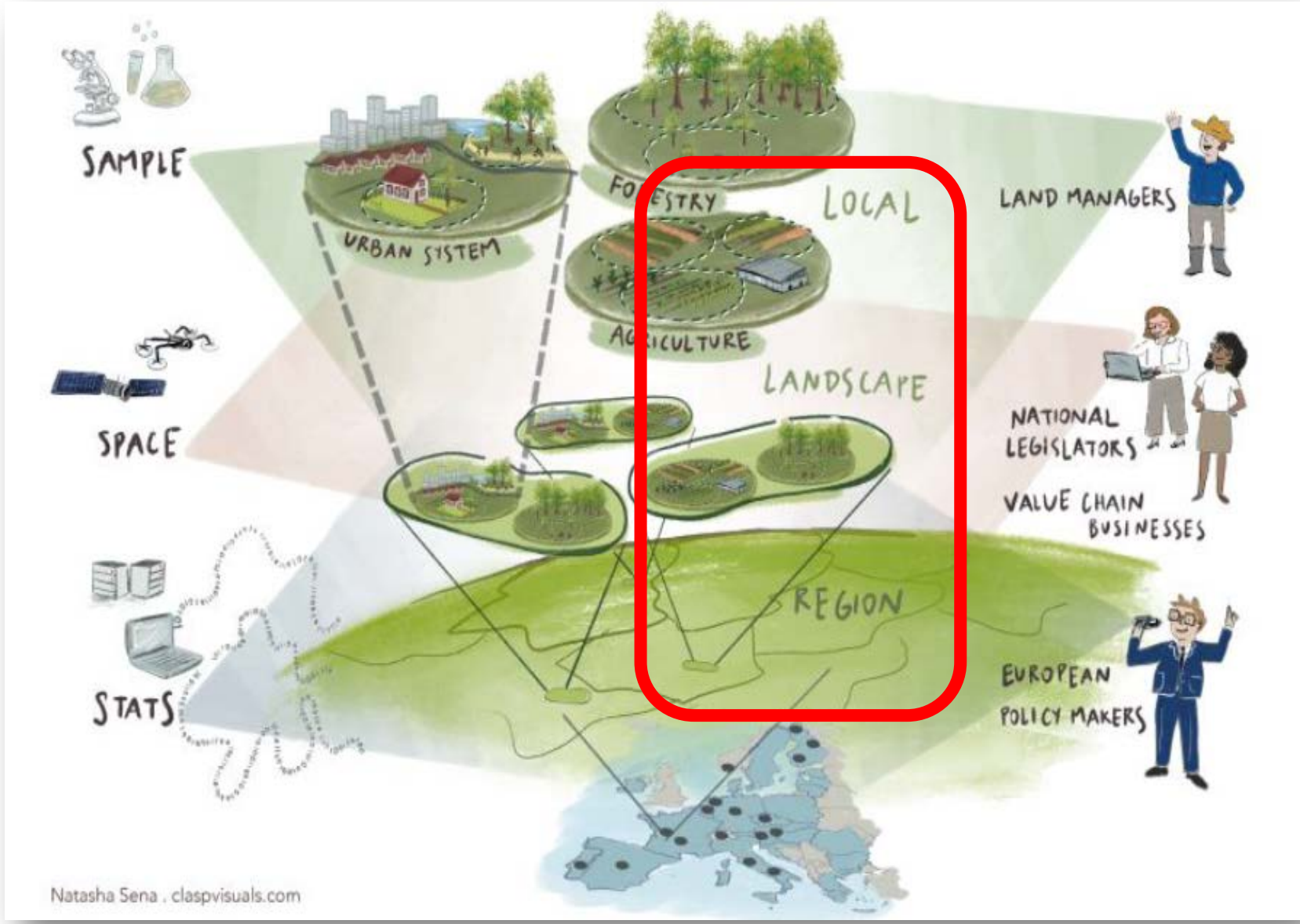
- 3 land-uses



BENCHMARKS concept

24 case studies (living labs)

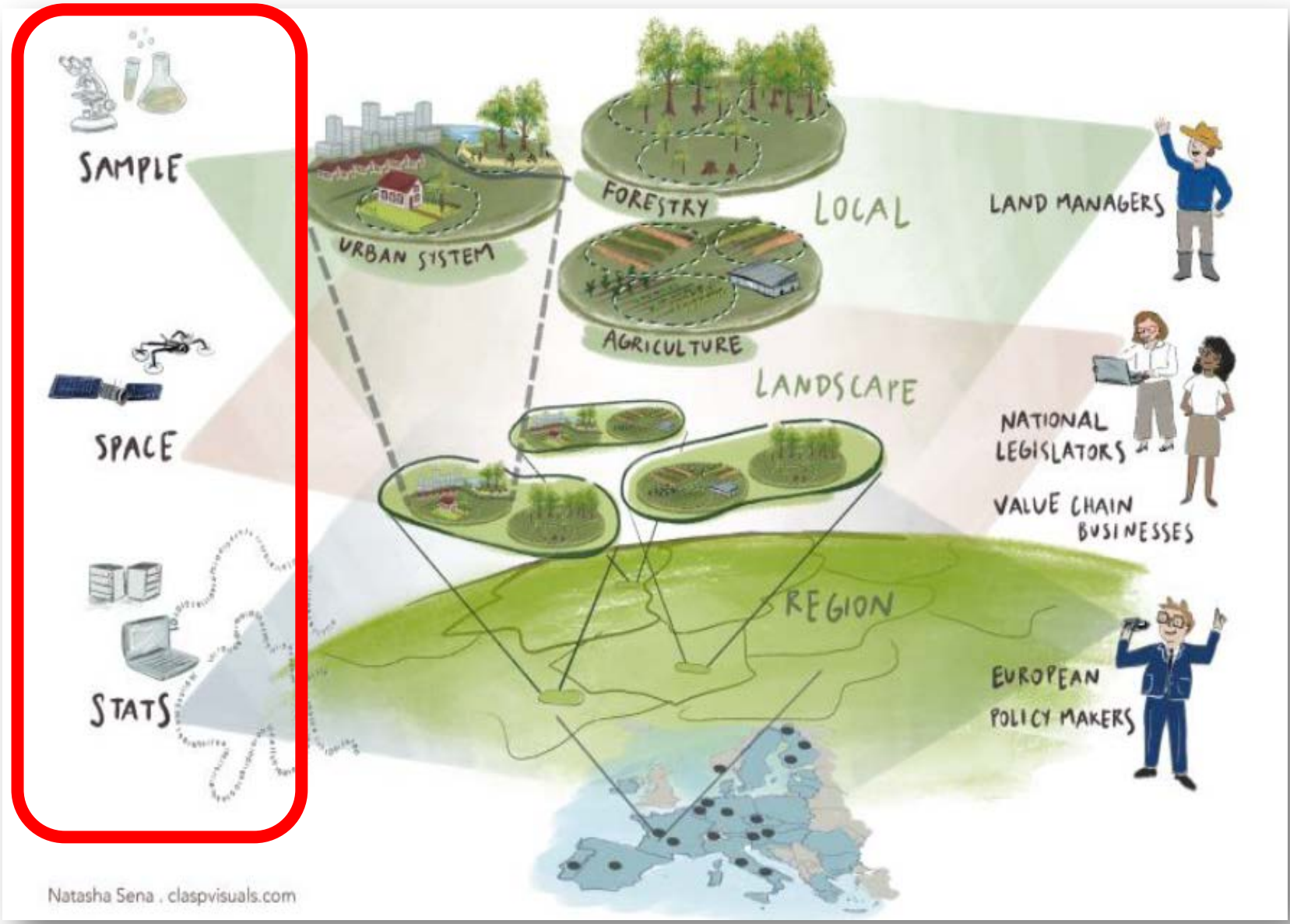
- 3 land-uses
- 3 scales



BENCHMARKS concept

24 case studies (living labs)

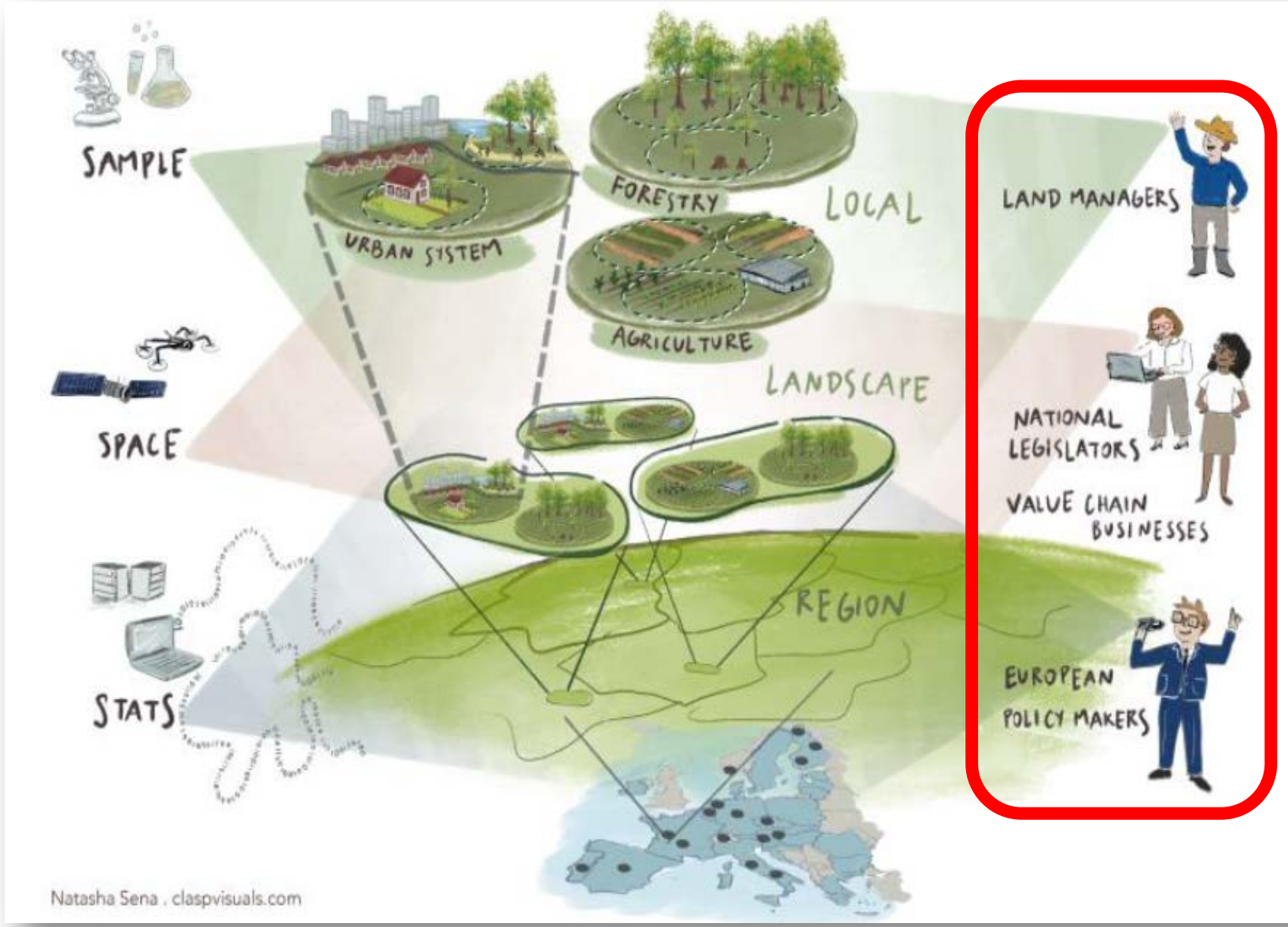
- 3 land-uses
- 3 scales
- 3 types of indicators



BENCHMARKS concept

24 case studies (living labs)

- 3 land-uses
- 3 scales
- 3 types of indicators
- multiple stakeholders



BENCHMARKS approaches

Multi-actor approach from start to end

- co-development & communication
- dissemination and exploitation
- project outputs → relevant, understandable and applicable for various stakeholders
- **workshops** in the case studies bringing together local land managers and diverse stakeholder groups

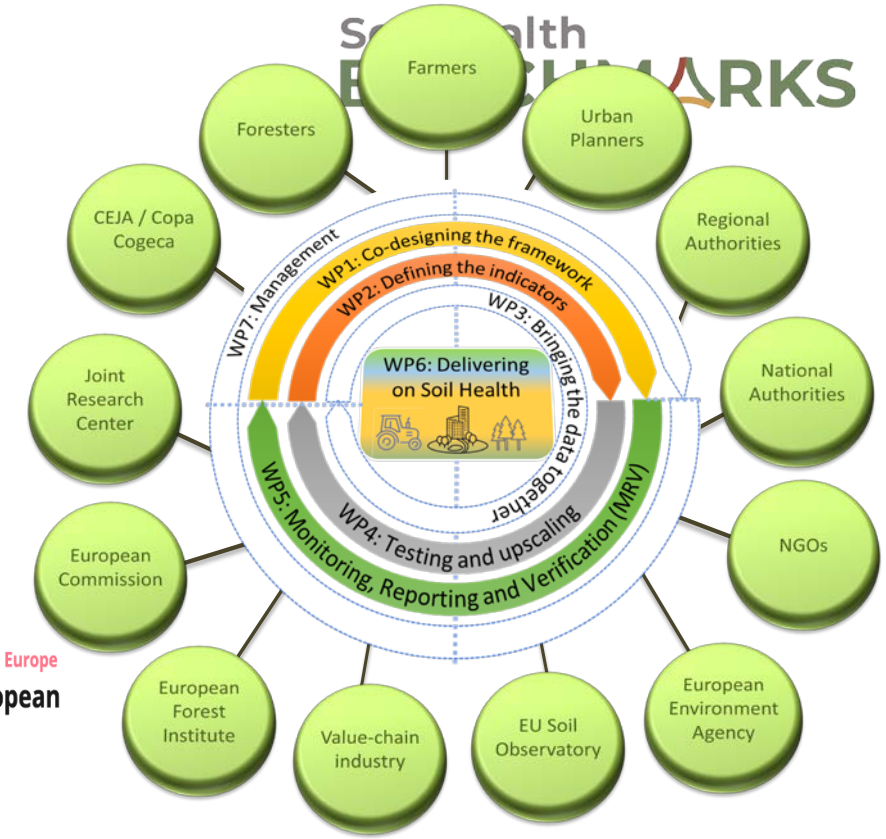
Year 1 Local (incl. landscape, region)
24 Landscape case study workshops (different scales)

Year 2 Europe
Workshop with the European Commission

Year 2 Region
Workshops with MRV users

Year 2 - 4 All
Stakeholder engagement in WP2,4 and 6

Year 4 All
Present outcomes of BENCHMARKS in 24 landscape case study workshops, to MRV users and European Comission

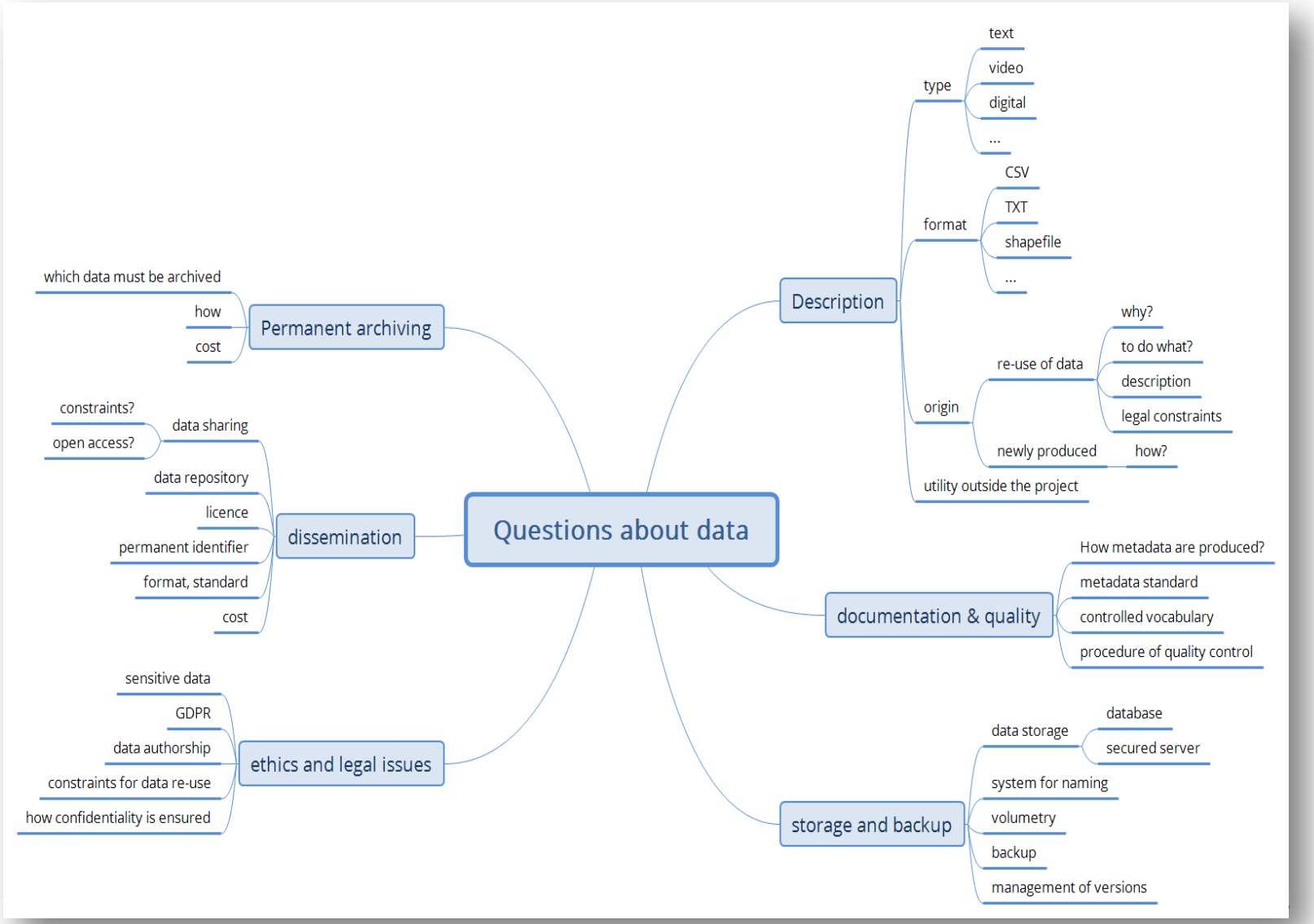


stakeholders from EU policymakers, through value-chain businesses, to land-managers and citizens (**citizen science**)

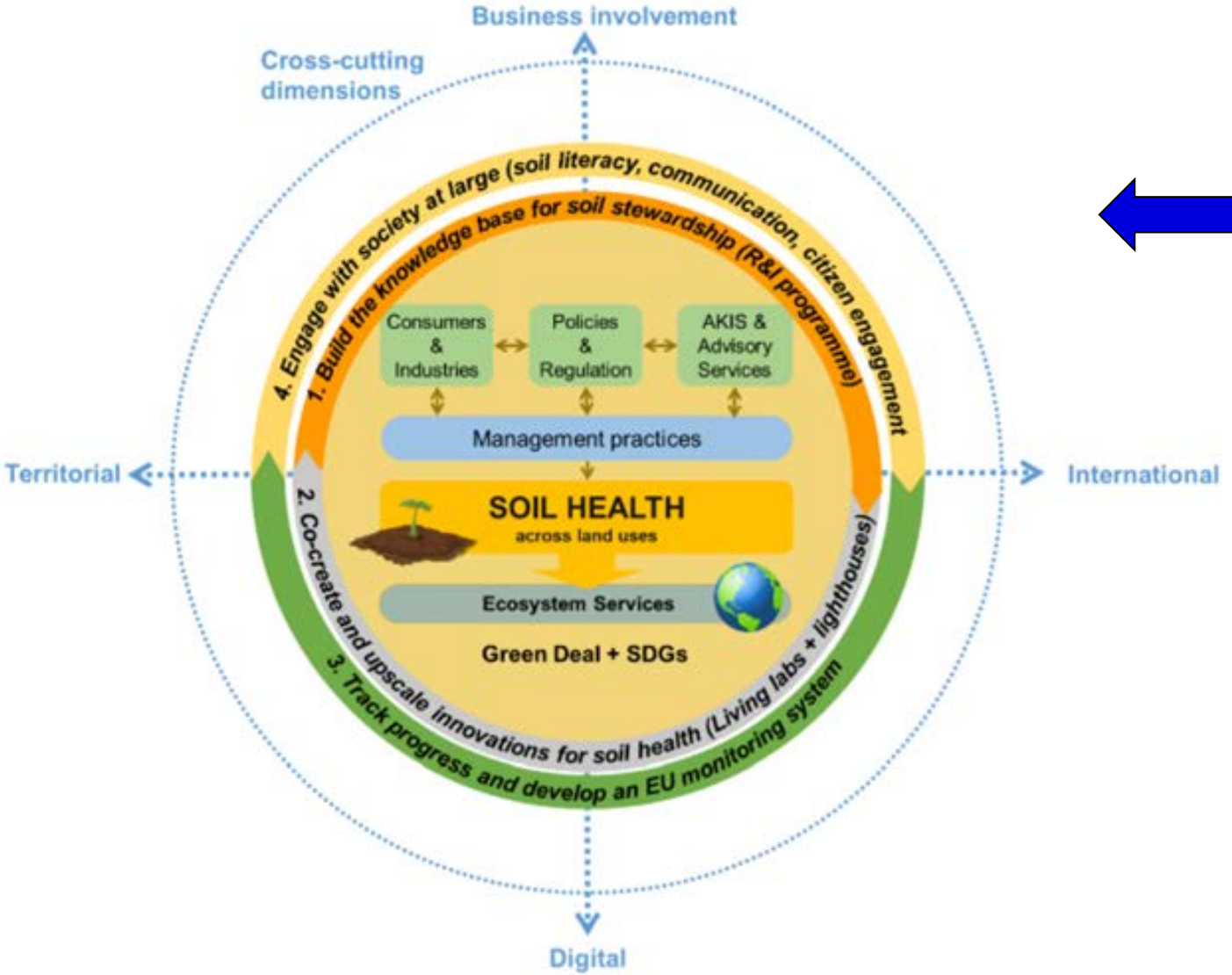
BENCHMARKS approaches

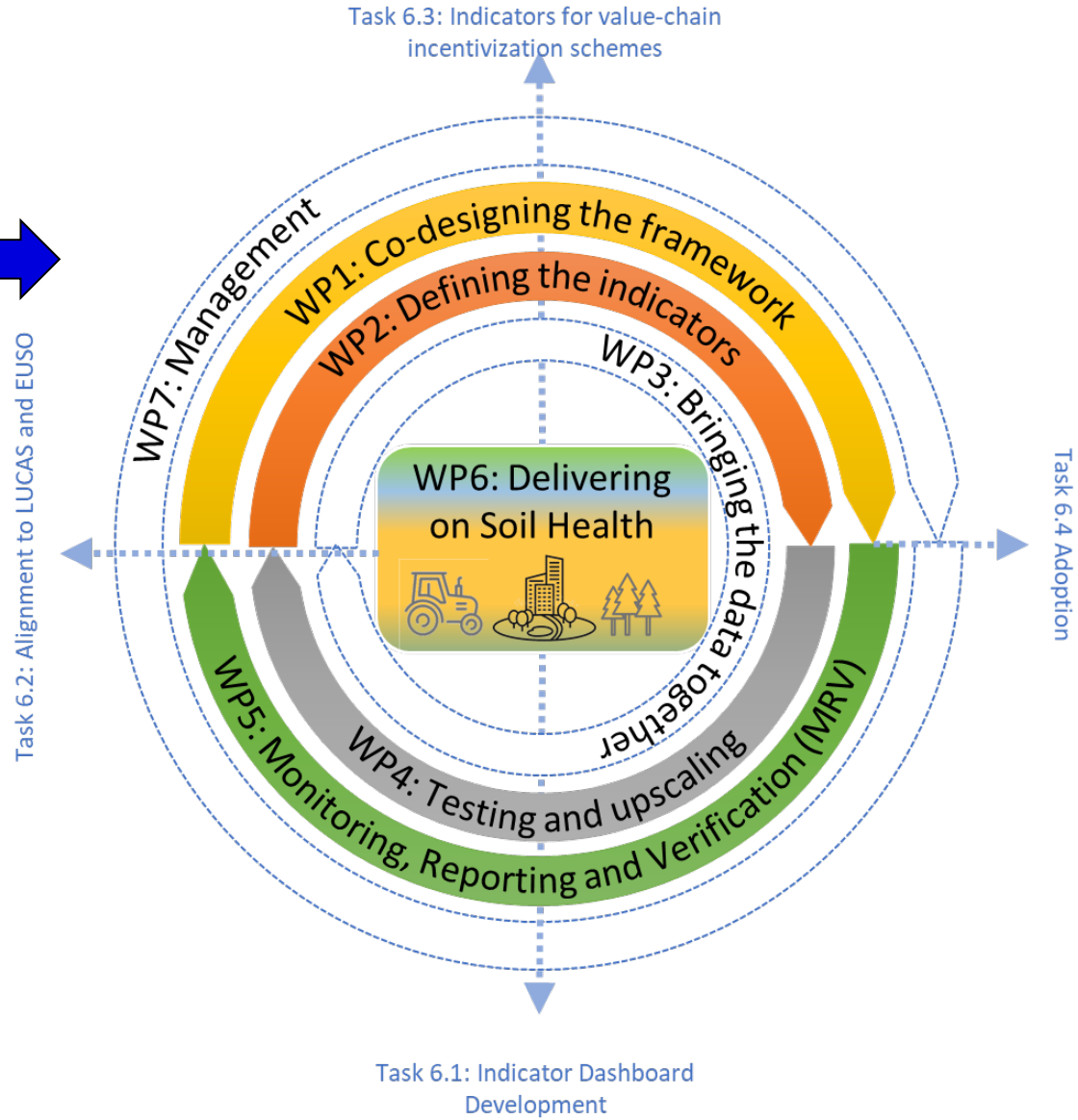
Open science

- project data and protocols are **Findable, Accessible, Interoperable and Reusable (FAIR)** and available via the **European Open Science Cloud (EOSC)**
- publications are **open source**



BENCHMARKS structure





MUNI | RECETOX

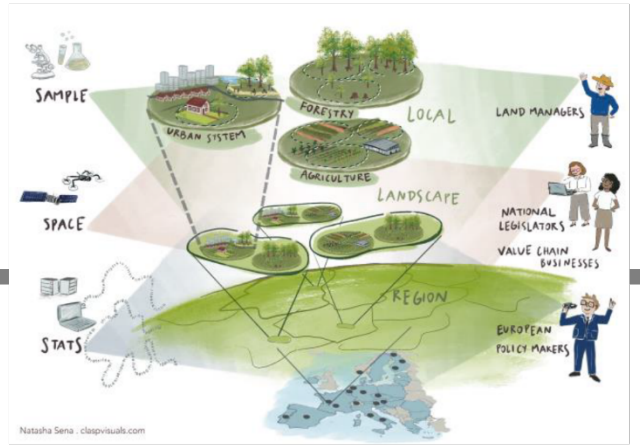
BENCHMARKS structure

Soil Health BENCHMARKS

Input

Existing 8 EU Mission indicators and datasets

24 Landscape Case Studies



Integrated Soil Health Monitoring Framework

Context

- **Objective**
- **Soil functions** which support the objective
- **Land use** under consideration
- **Pedo-climatic region** within Europe
- **Scale of assessment** of the application of the indicator measurements
- **User type** the type of information required

Monitoring Metrics

- **Practice** – defines which management practices can be implemented to respond to the objective set out in the context.
- **Result** – are useful to monitor and report a change in the short term as a result of the implementation of a practice/new technology.
- **Outcome** – are useful to monitor and report the extent to which the intervention / initiative has delivered on its goals.

Indicator Measurements

- **Sample** – field and lab based measurement
- **Stats** – existing data on; soils, management practices, socio-economic factors & model derived measurements.
- **Space** - digital technologies, e.g. remote sensing, satellite technology, lidar, drones

Key results and outcomes

Dashboard
w/ JRC

- Harmonised indicator selection framework
- Soil Health Assessment and Index
- Management practices for optimisation

- Link soil health, functions and ecosystem services
- Scientific underpinning of soil health schemes

Co-develop and communicate | WP1
Define indicators | WP2
Integrate data | WP3

Testing and upscaling | WP4
Monitoring, Reporting & Verification | WP5

TRL 2-3

Delivering on Soil Health | WP6

TRL 4-5

Key impacts

Scientific:
Framework for soil health in Europe to support soil strategy and SH&F mission

Economic:
Support sustainability strategies for businesses of 24 value-chains

Societal:
480 land managers engaged towards 75% healthy soils by 2030

Case studies – Czech Republic

Brno

- cca 270 km2
- cca 380,000 inh.
- range of urban typologies, including semi-natural city forests, artificial parks, and **urban gardens**

Brno city region - north

- cca 800 km2
- landscape defined by the presence of forests, urban forests, other land uses

BENCHMARKS summary

MUNI | R

SPECIFIC NEEDS

A soil health monitoring framework that supports **a harmonised reporting structure at EU, national and local levels for soil health**

Better scientific knowledge on the suitability and reliability of the SH&F indicator measurements.

Demand from European policy for support in ensuring 75% healthy soils across Europe by 2030 in line with Green Deal commitments and targets

Need for scientific underpinning of soil health initiatives by value-chain businesses.

EXPECTED RESULTS

Harmonised and cost-effective soil health monitoring framework: through co-development and testing in 24 Living Labs

Multi-scale monitoring system: using sample, stats and space indicator measurements for state and change assessment, with appropriate proxy indicators for assessment at coarser scales.

Soil indicator selection tool, benchmarking and soil health index for inclusion in the soil health dashboard to support to the SH&F mission and JRC in achieving soil health targets by 2030.

Mainstream soil health monitoring: through scientific underpinning of value-chain soil health incentivisation programmes.

D & E & C MEASURES

Communication for building trust and knowledge with stakeholders in 24 Living Labs to co-design the framework and test the indicators in 17 regions of Europe.

Disseminate accessible and widely-understandable (translated) scientific and technical knowledge, shared through a range of multi-media resources, open-source journals, video blogs by users and citizen science tools. Linking to other soil mission resources and projects through online media channels.

Jointly assess exploitation measures with the EC and JRC to embed soil health monitoring across Europe to support the Soil Strategy and Soil Health law.

Engage with 24 value-chain businesses in the Living Labs to **mainstream, disseminate and exploit** soil health programmes and incentivise sustainable soil management.

TARGET GROUPS

Land managers: Farmers, Foresters, Land planners, citizens

Public actors: policy makers, planners, multi-level governance

Private actors: advisory services, technologists, value-chain businesses, NGOs.

Knowledge Institutes: Universities, research institutions, Secondary education

OUTCOMES

A **harmonised and cost-effective framework for measuring soil health**, based on a widely agreed definition of soil health to support the further development of European policy.

Review of SH&F and BENCHMARKS proposed indicators tested in the 24 Living Labs (with > 480 land managers) to significantly improve capacities for soil health assessment by 2026

Provide the scientific evidence **on the links between soil health, soil functions and ecosystem services in an integrated soil health tool** to be included in the EC Soil Health Dashboard

Provide the scientific underpinning of **soil health incentivisation schemes** to be adopted by 24 value-chain businesses.

IMPACTS

Scientific: evidence on the soil health indicators proposed by the SH&F Mission and Benchmarks to support policy developments and monitoring, verification and reporting in Europe as aimed for by the new EU Soil Strategy and proposed Soil Health Law by 2030.

Economic: Integration of scientific models into sustainability strategies of 24 businesses of value-chains for deployment in the future.

Societal: to achieve the transition towards 75% healthy soils by 2030 for food, people, nature and climate. By increasing adoption of sustainable soil management to ensure; food quality, clean water, habitats for biodiversity, climate resilience and support a wider range of ecosystem services in rural and urban landscapes.

Thank you for your attention !

jakub.hofman@recetox.muni.cz

„BENCHMARKS proposes a solution that will support all these different user needs, but at the same time provide an over-arching harmonised framework from which to select indicators and set thresholds for a soil health index. By employing this holistic and integrated approach, intensive stakeholder interaction throughout the 5 year period, and a clearly defined programme for dissemination, exploitation and communication, BENCHMARKS ensures broad adoption of the project's multiple and aligned outcomes, thus achieving lasting and significant impact on (1) scientific, (2) economic, and (3) societal levels. BENCHMARKS thereby provides an essential element for the implementation of the SH&F mission."