



EUROPEAN UNION

EUROPEAN MISSION SOIL WEEK

Break-out session 7 –
The vital role of soil biodiversity

22nd of November 2023



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#MissionSoilWeek #MissionSoil #EUMissions



Agenda

- Introduction (10')
- Round of presentations (60')
- Panel discussion (20')
- Q&A (15')
- Participatory exercise (10')
- Conclusions and closing (5')

Growing attention for soil biodiversity and outreach

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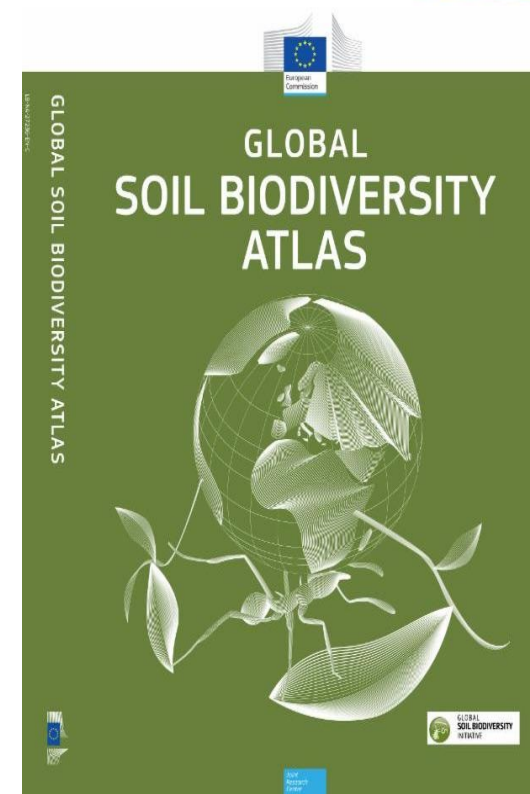
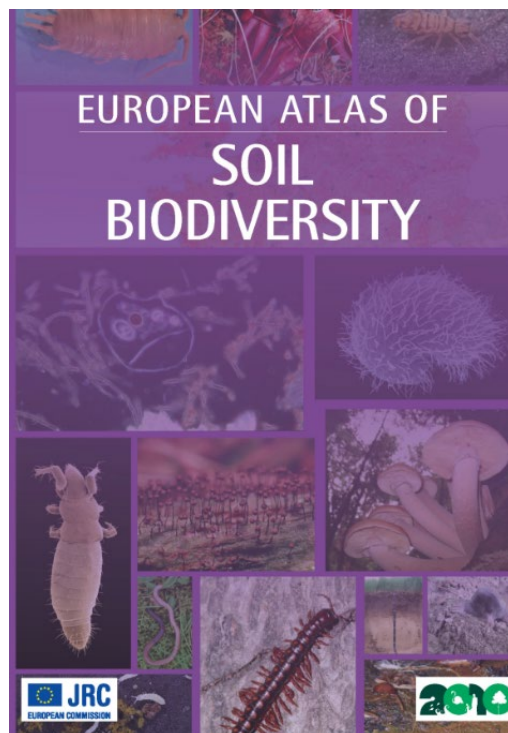
GLOBAL
SOIL BIODIVERSITY
INITIATIVE

A SCIENTIFIC EFFORT

HOME BACKGROUND PARTICIPANTS ACTIVITIES MEETINGS RESOURCES NEWSROOM BLOG CONTACT US MEMBERS AREA

PARTICIPATE TODAY

Keep us expanding - join today!



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Soil biodiversity high on policy agenda

- Major decision on Soil Biodiversity monitoring and protection adopted at COP-15 of Convention of Biological Diversity (CBD) in Montreal, QC, December 2022
- The plan of action 2020-2030 for the international initiative for the conservation and sustainable use of soil biodiversity
- *On 5th July 2023*, the EU proposed a new Soil Monitoring Law to protect and restore soils and ensure that they are used sustainably.

How to measure soil (biodiversity)?

- Several initiatives are already taking place: JRC-LUCAS, SoilBON, NETSOB, national initiatives
- How to link these initiatives?
- How to find effective indicators and sampling designs?
- How to keep this practical for land owners and land managers?
- How to feed back results to policy and new research programming?



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Our speakers

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Alberto Orgiazzi

Research Consultant

*European Commission, Joint
Research Centre*



Jacob Parnell

Soil Biodiversity Specialist

*Food and Agriculture Organization
of the United Nations*



Maria J. I. Briones

Professor of Zoology

University of Vigo (Spain)



Gérard Rass

General Secretary

*Association for the Promotion of
Sustainable Agriculture (APAD)*

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1st European assessment of soil biodiversity

Alberto Orgiazzi

Research Consultant - European Dynamics/Joint Research Centre

X @ultimoalbero

22/11/2023



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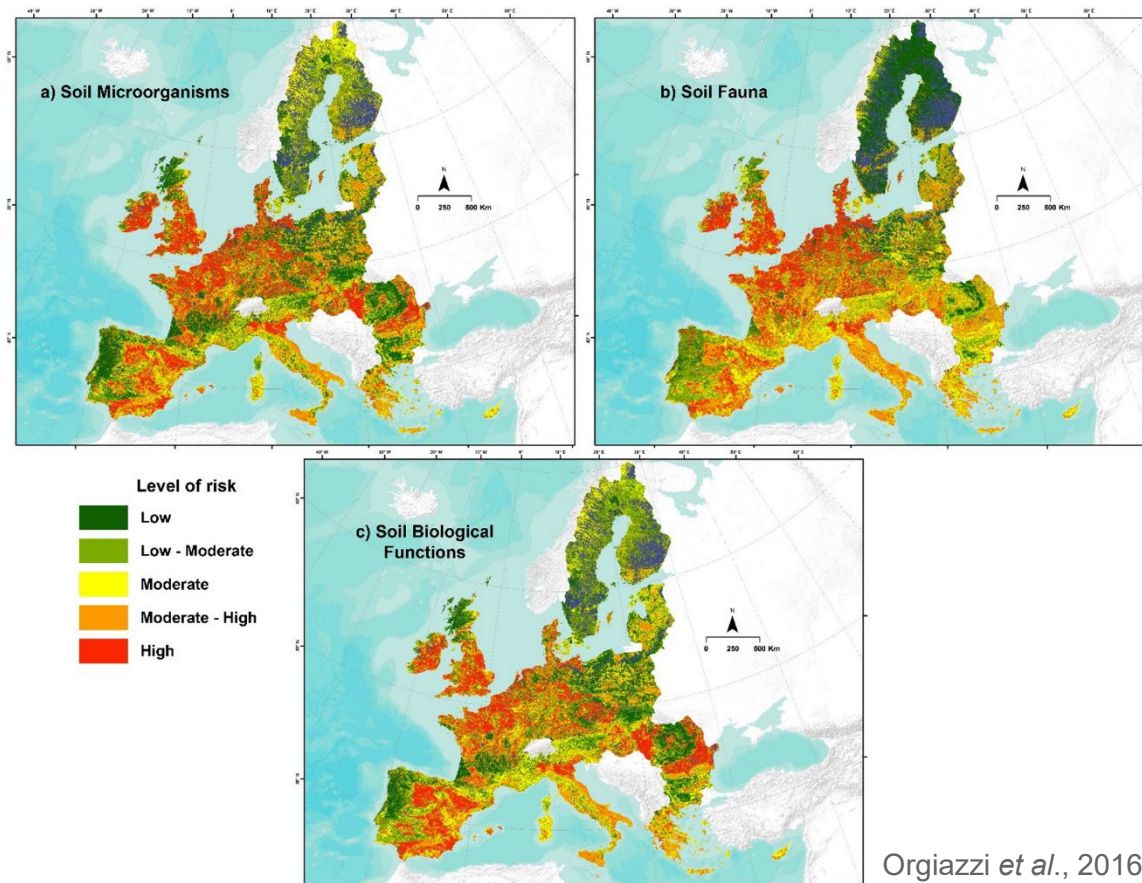
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BACKGROUND

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Soil organisms are under threat



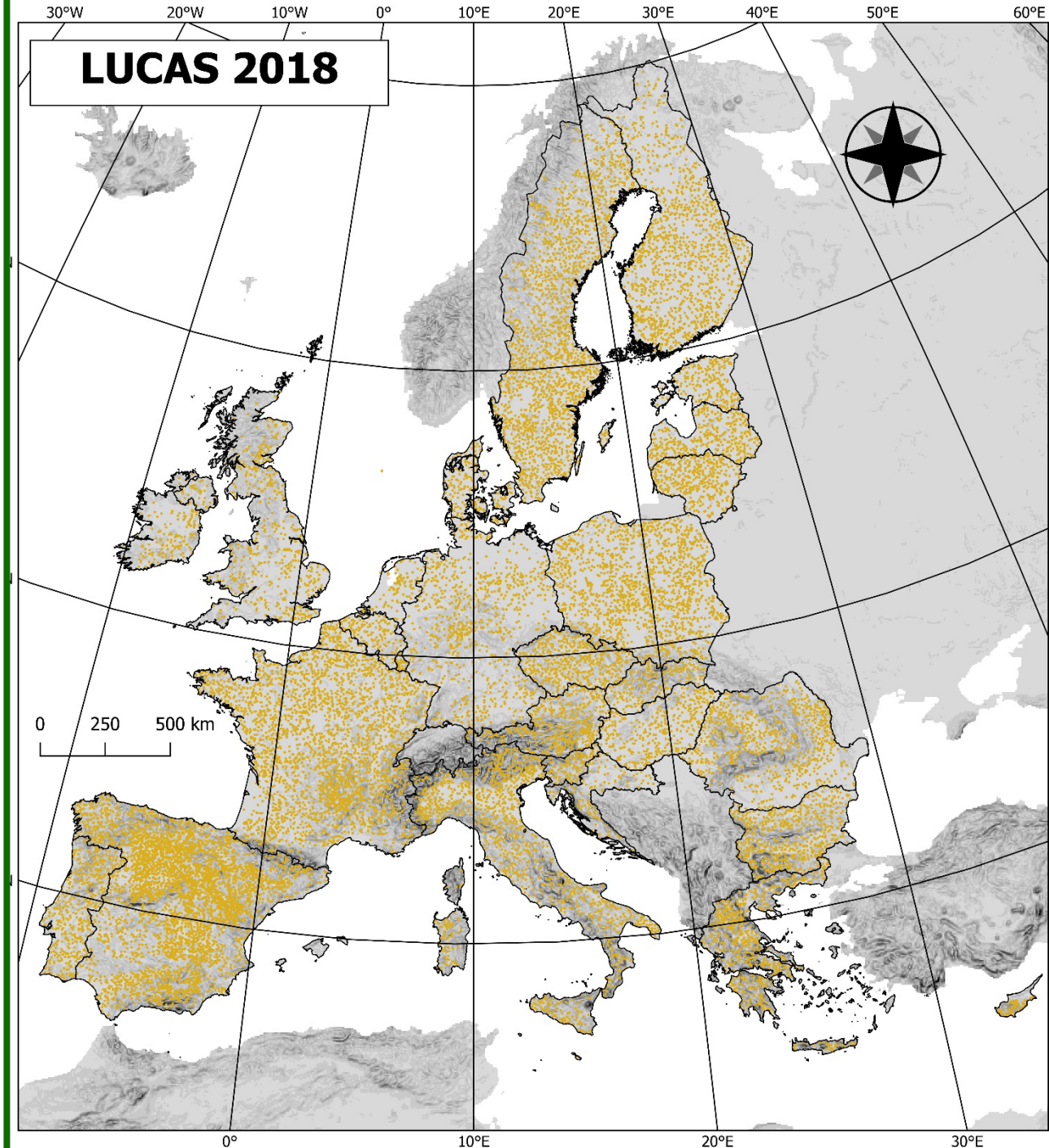
Orgiazzi *et al.*, 2016



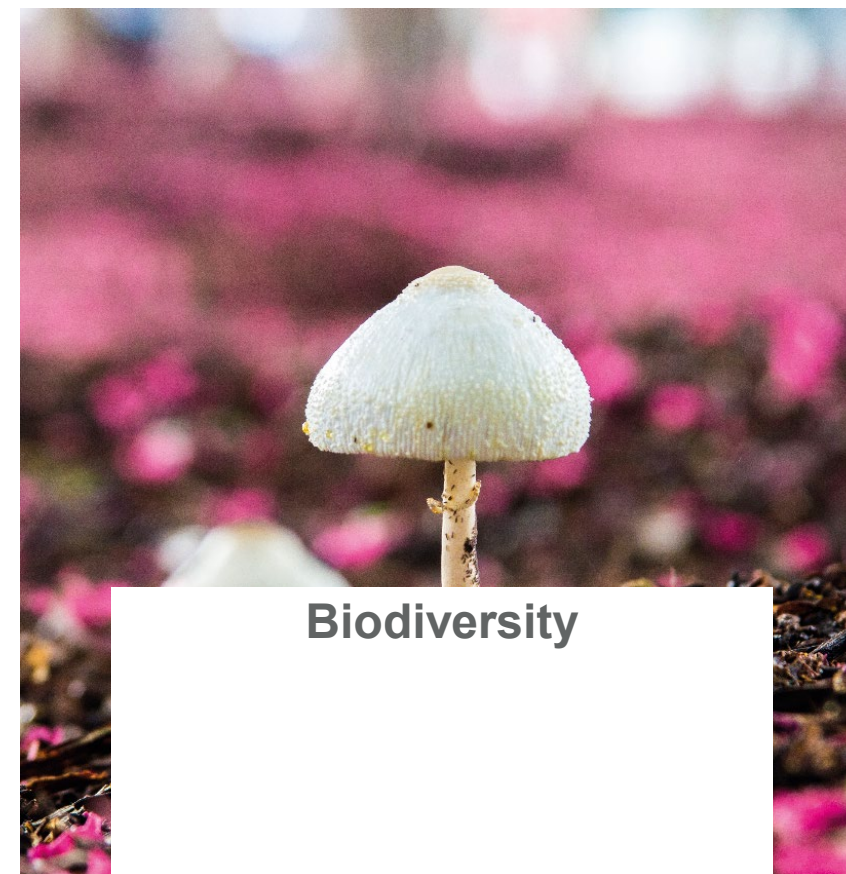


LUCAS Soil

- Largest EU soil survey
- 2009 – every 3 years
- Joint Research Centre
- 20,000-40,000 points
- Physico-chemical properties



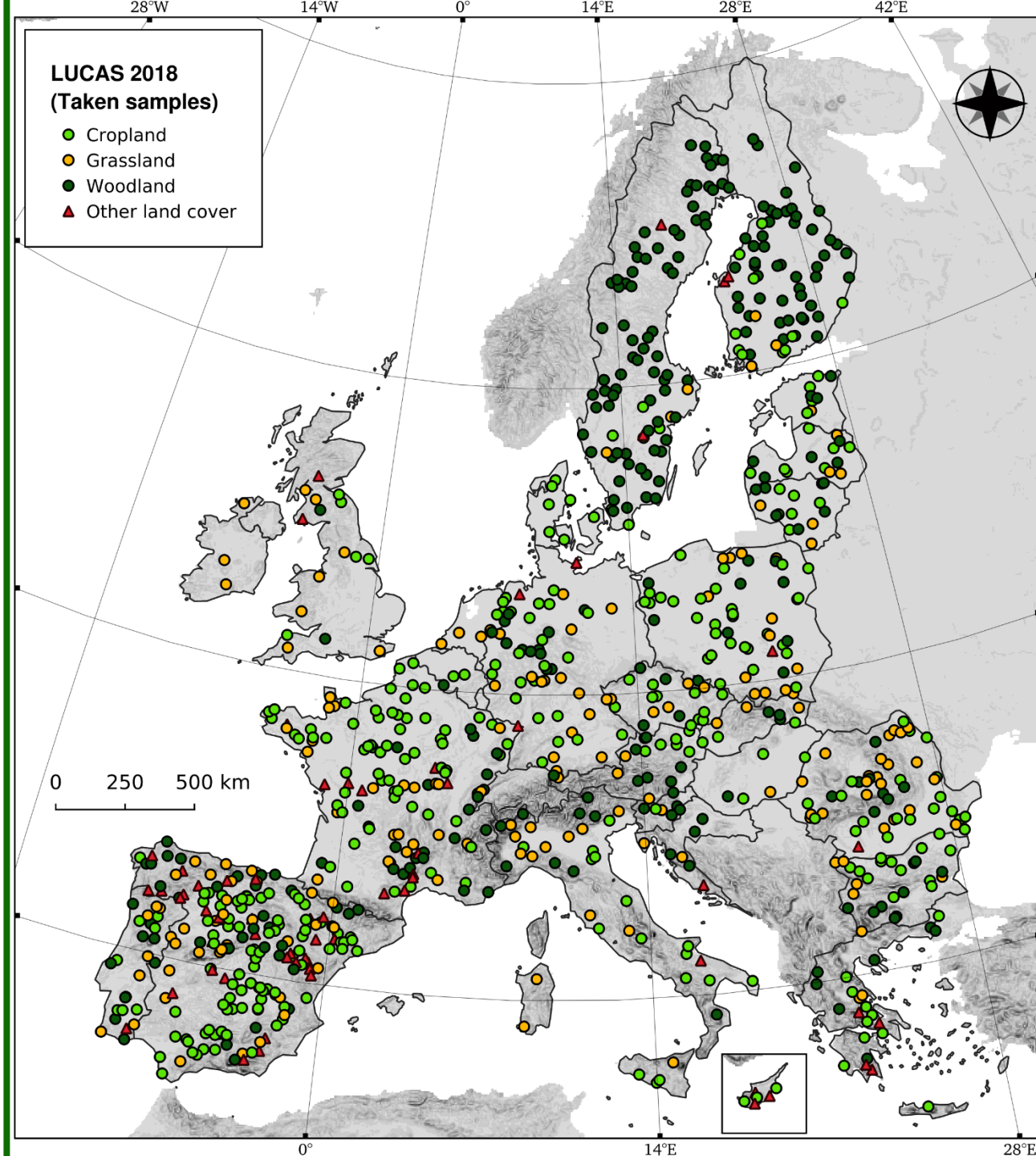
LUCAS Soil growing up



New parameters measured as of 2018

LUCAS Soil Biodiversity

- 2018
- 1,000 selected points
- 885 collected samples
- Soil DNA
- Microbes and animals



LUCAS Soil Biodiversity

- Standard protocols
- Short time frame for sampling (spring-summer 2018)
- Complex logistics
- Largest EU soil bio (DNA) dataset





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FINDINGS

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EU Soil Strategy for 2030 says...

“...publishing the first assessment of EU soil biodiversity...”

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[nature](#) > [nature communications](#) > [articles](#) > [article](#)

Article | [Open Access](#) | [Published: 08 June 2023](#)

Patterns in soil microbial diversity across Europe

[Maëva Labouyrie](#), [Cristiano Ballabio](#), [Ferran Romero](#), [Panos Panagos](#), [Arwyn Jones](#), [Marc W. Schmid](#),
[Vladimir Mikryukov](#), [Olesya Dulya](#), [Leho Tedersoo](#), [Mohammad Bahram](#), [Emanuele Lugato](#), [Marcel G. A.](#)
[van der Heijden](#) ✉ & [Alberto Orgiazzi](#) ✉

[Nature Communications](#) **14**, Article number: 3311 (2023) | [Cite this article](#)



RESEARCH ARTICLE | [Open Access](#) | 

Ecosystem type drives soil eukaryotic diversity and composition in Europe

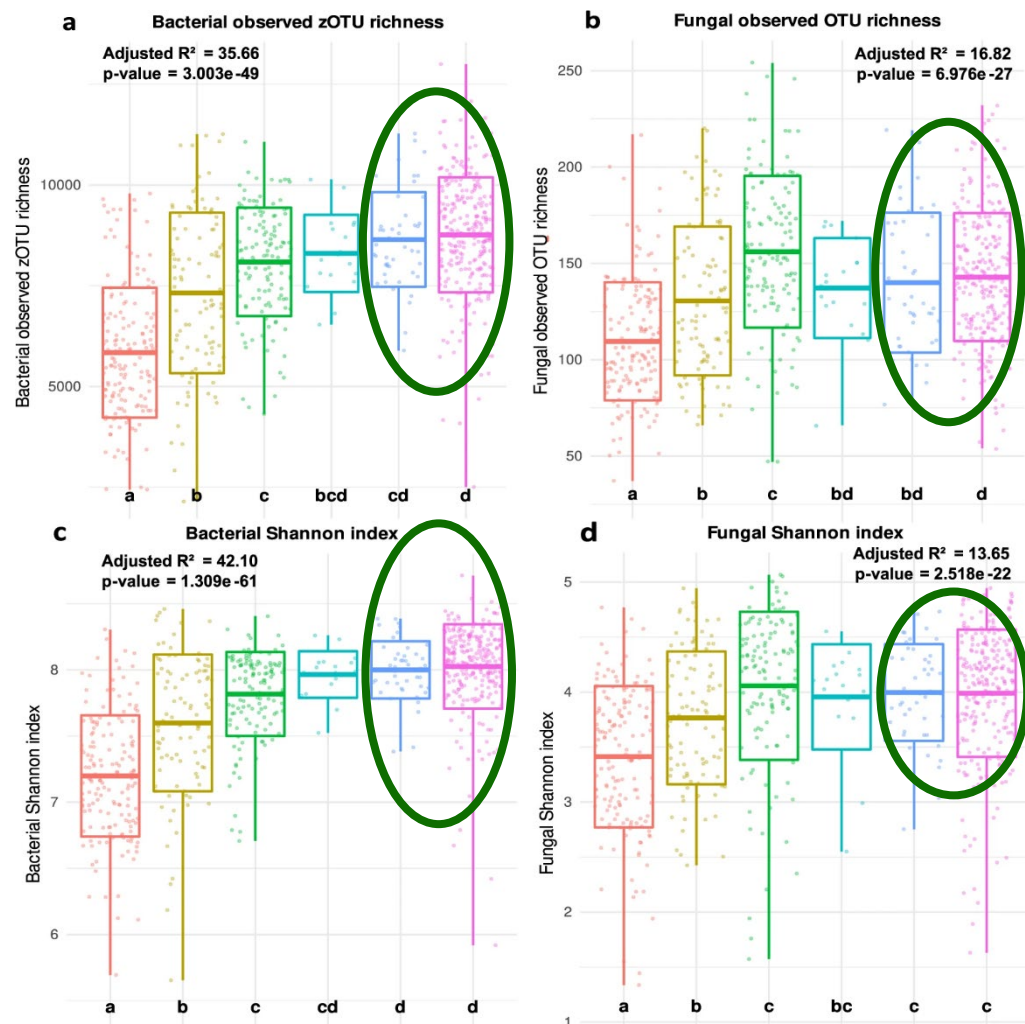
[Julia Köninger](#), [Cristiano Ballabio](#), [Panos Panagos](#), [Arwyn Jones](#), [Marc W. Schmid](#), [Alberto Orgiazzi](#) ✉,
[Maria J. I. Briones](#) ✉

First published: 14 July 2023 | <https://doi.org/10.1111/gcb.16871>

Thanks to Maeva and Julia!
PhD students with
Uni of Zurich and Vigo



Soil microbes



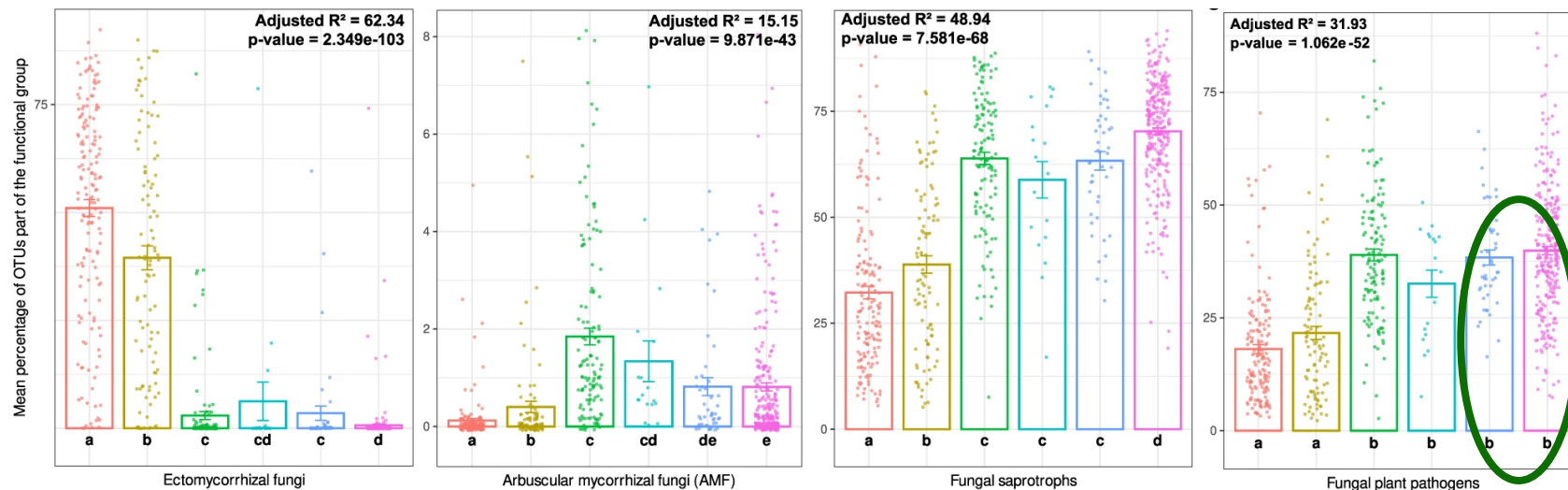
More intensively used lands (croplands) are richer in soil microbial diversity

Drivers of diversity

- soil properties
- climate
- vegetation



Soil microbes



- Not just taxonomy also functions
- Functions tell a different story
- Plant pathogens more abundant in croplands



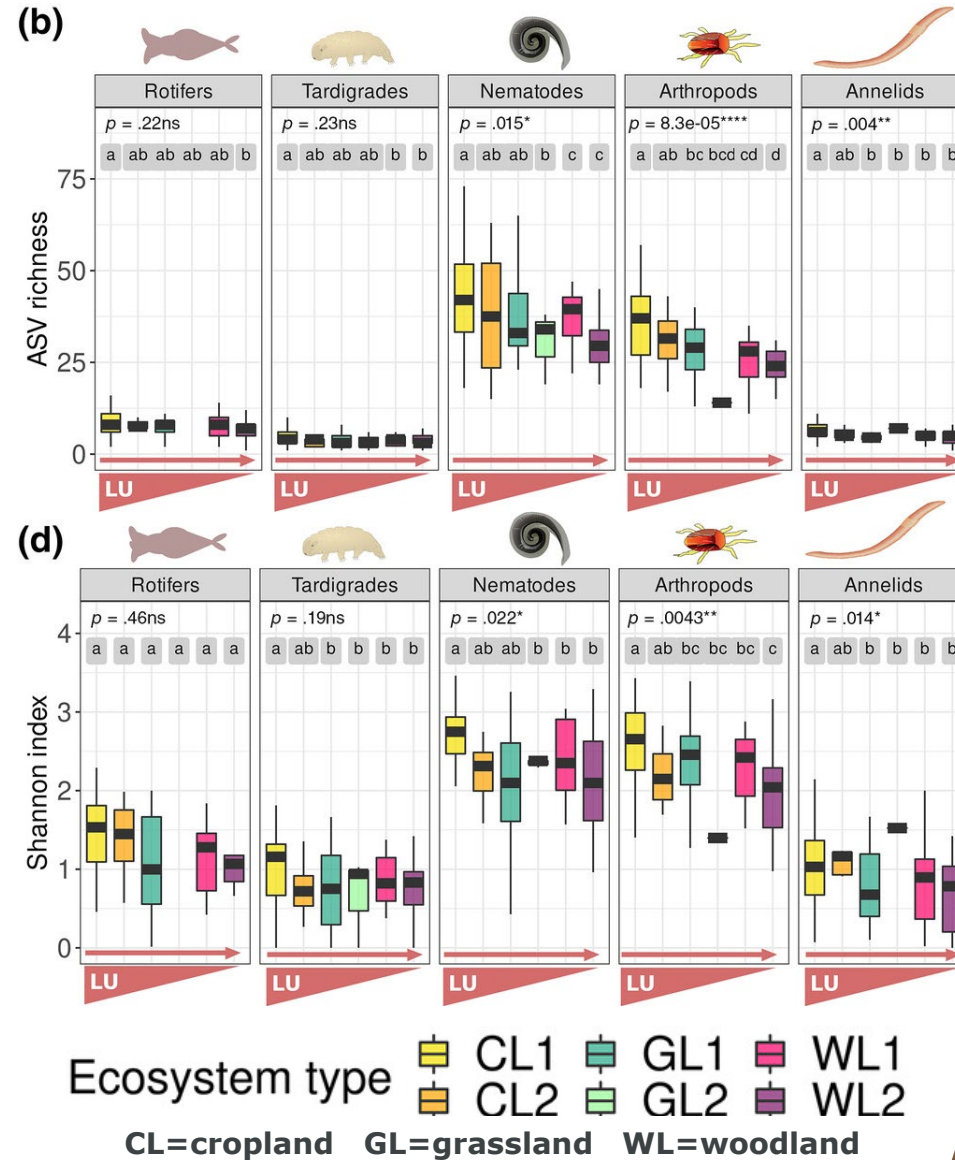
Soil animals

Same story

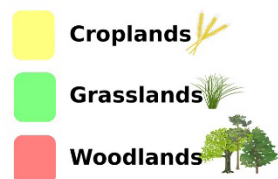
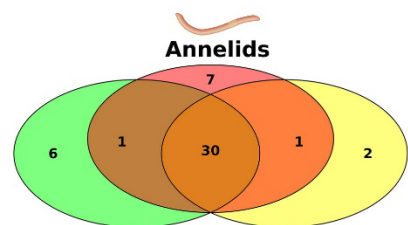
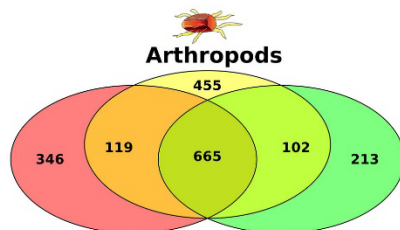
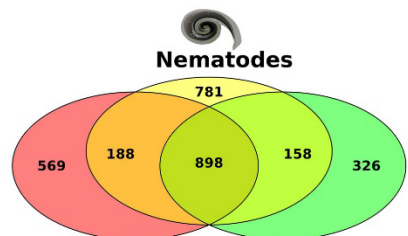
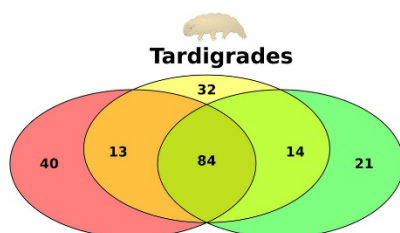
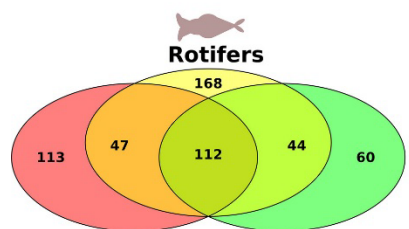
Food web effect



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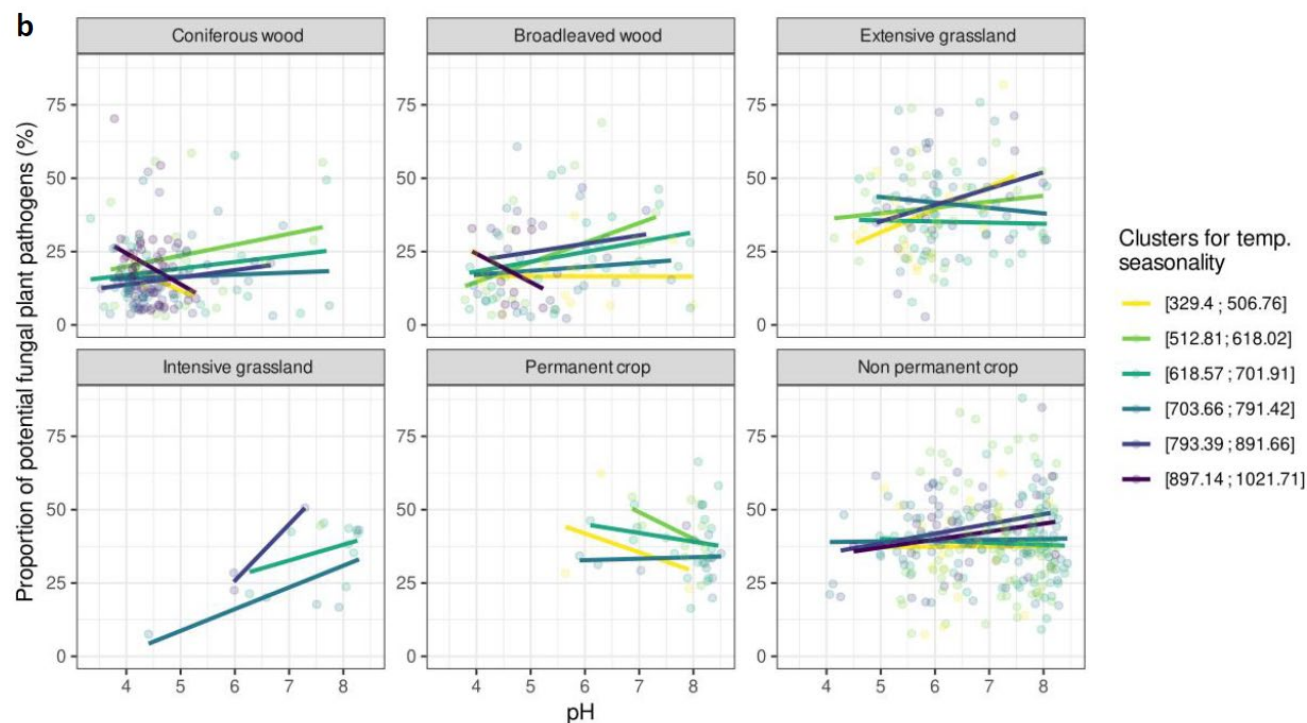
Soil animals



- Overlapping taxa among land use types
- Importance of historical variables (land use and climate)
- Legacy effect
- Further analysis



Soil biodiversity conservation



- Drivers (soil properties, climate & vegetation)
- Areas of action: cluster (district) approach
- Applicable to taxonomy & functions
- Applicable at local scale (data availability)



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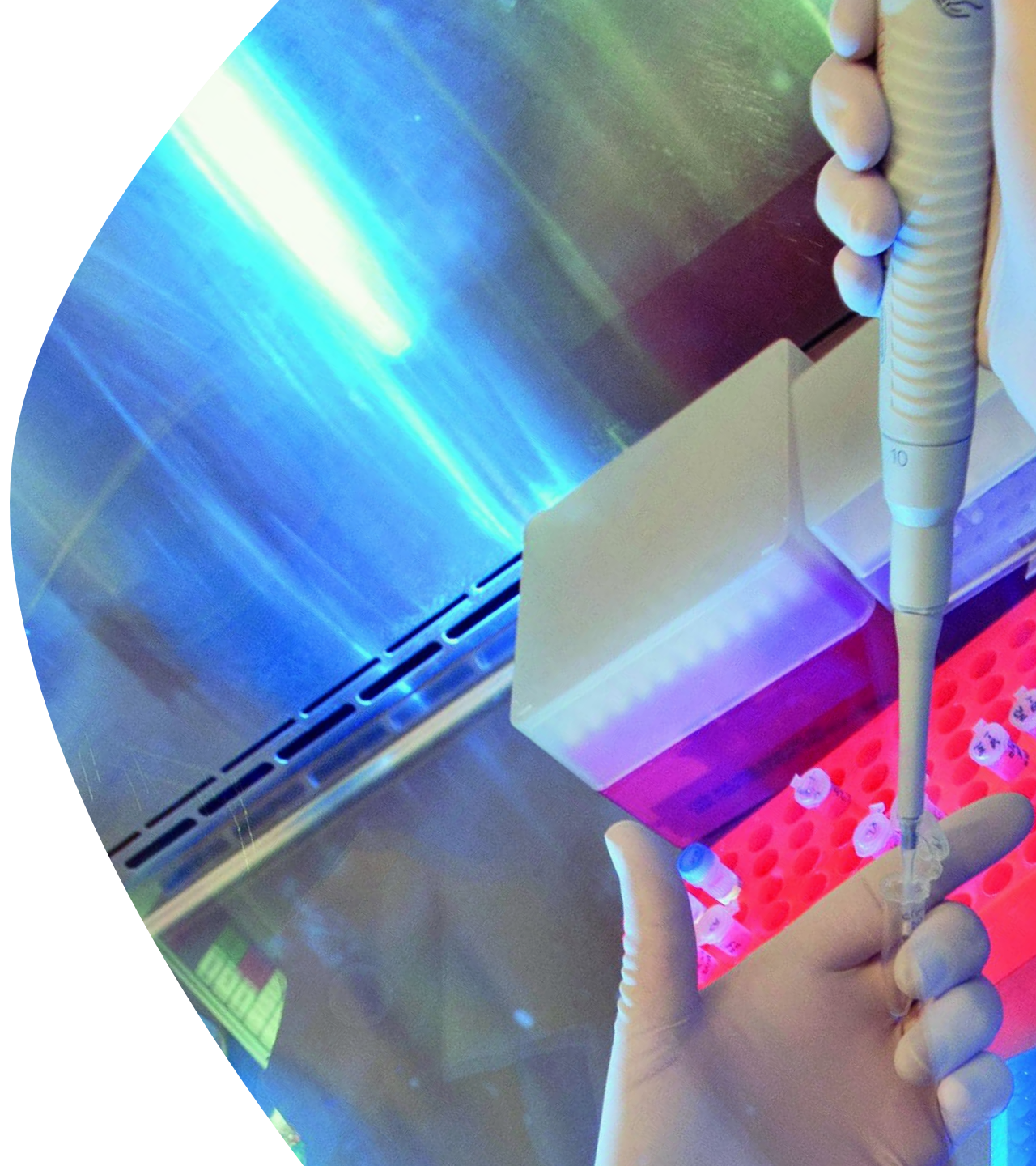
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WHAT NEXT?

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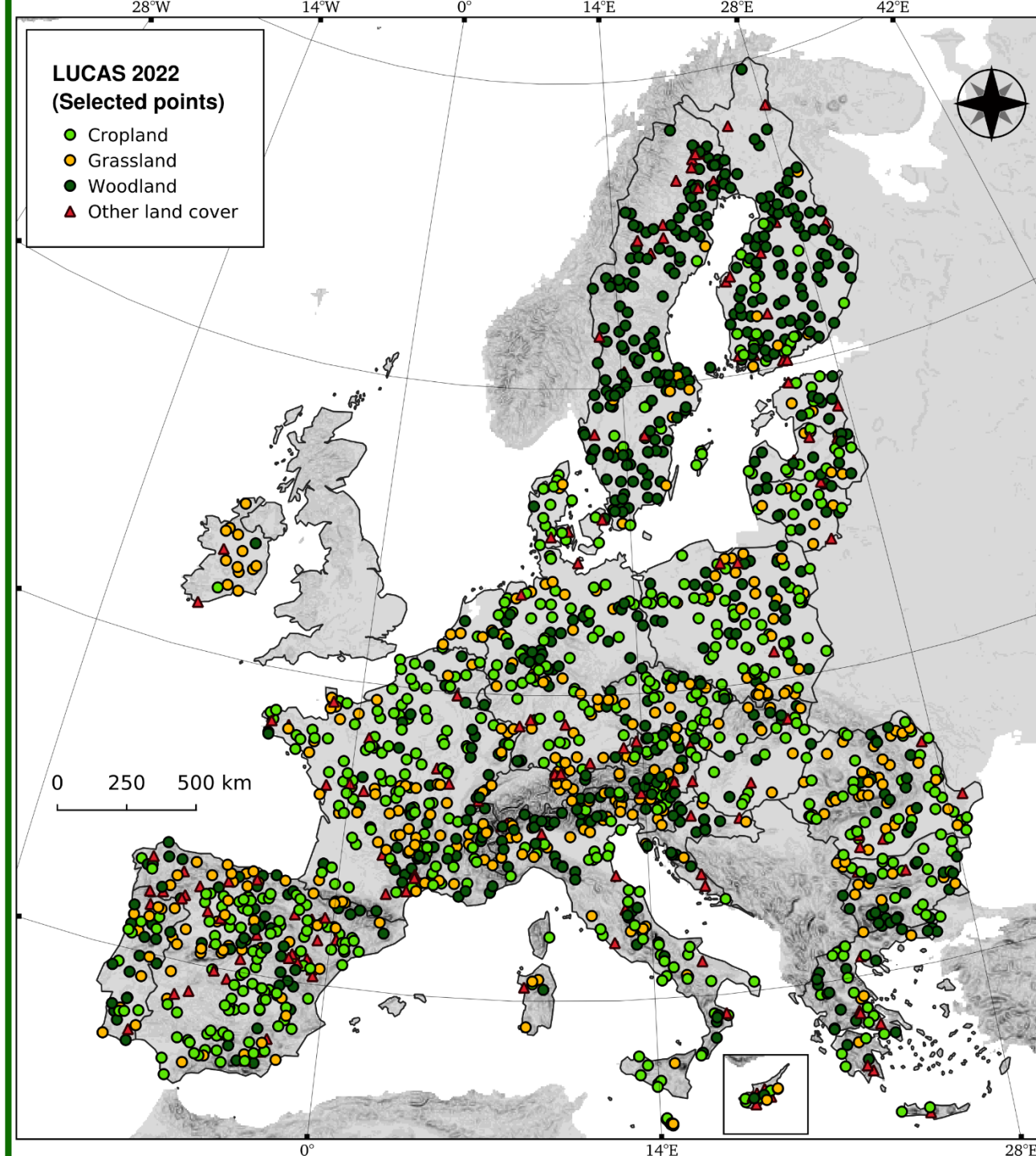
Ongoing analyses

- Antimicrobial resistance genes
- Nutrient cycling genes
- Soil biodiversity and pesticides
- Soil viruses
- Use of genes as bioindicators



New campaign

- 2022
- Double points: ~1,500 collected
- Monitoring scheme:
is soil biodiversity declining?
- Soil biodiversity for soil health
assessment
(proposal EU Soil Monitoring Law)



LUCAS Soil Archive

- 100% open access
- Data download
European Soil Data Centre (ESDAC)
- Produce data through LUCAS Soil protocols
- Take soil samples for your analysis
- Fresh (frozen) soil samples also available



Take-home messages

Take both taxonomic and functional diversity into account

Soil microbial and animal richness and diversity are higher in croplands but may be associated to a larger presence of potential pathogens

Soil biodiversity conservation may be feasible

Cluster approach based on drivers is an option that can be applied to both taxonomical and functional groups

Knowledge gaps

What biodiversity do we want to protect? Is there a good or bad biodiversity?
Relic DNA and functional information are still poor

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Thank you!

Email: alberto.orgiazzi@ext.ec.europa.eu

Website: European Soil Data Centre
<https://esdac.jrc.ec.europa.eu/>

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Soil Biodiversity: The Foundation of One Health

Jacob Parnell

Soil Biodiversity Specialist



Food and Agriculture Organization of the United Nations

November, 2023



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Soils are beautiful and provide multiple ecosystem and productive services



Provision of fiber



Aesthetics



Provision of wood



Provision of support
for animals



Carbon storage and
greenhouse gas
regulation



Cultural identity



Provision of food



Regulation of pests and
disease populations



Filtering of nutrients
and contaminants



Heritage values



Provision of support
for human



Flood mitigation



Detoxification and
recycling of wastes



Recreation



Provision of raw

Soil Biodiversity: a solution to current global problems in 2023

Pollution



Fertilizer crisis



Food insecurity



Microbiome



Antimicrobial resistance



Carbon sequestration



Pest and diseases

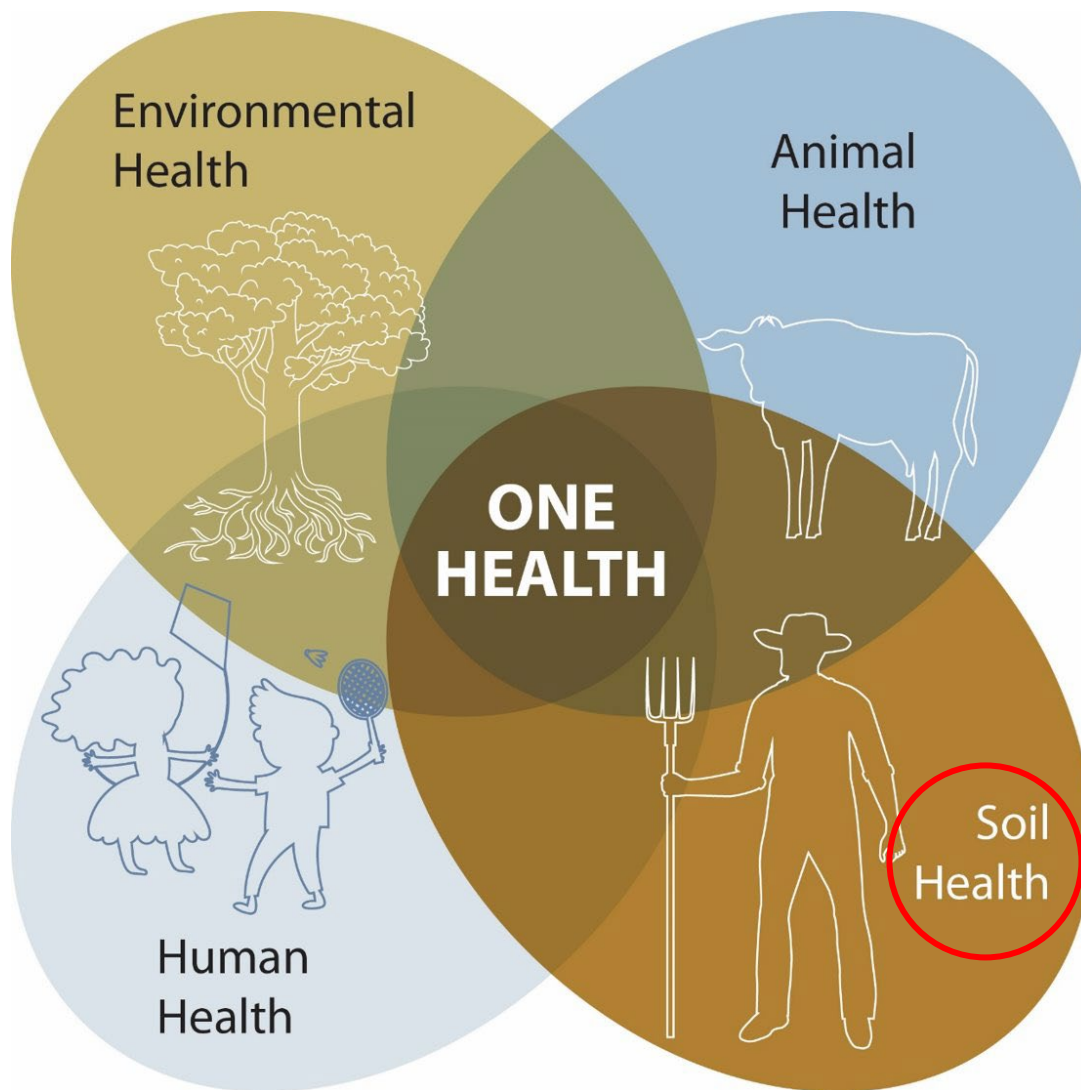


Biodiversity loss





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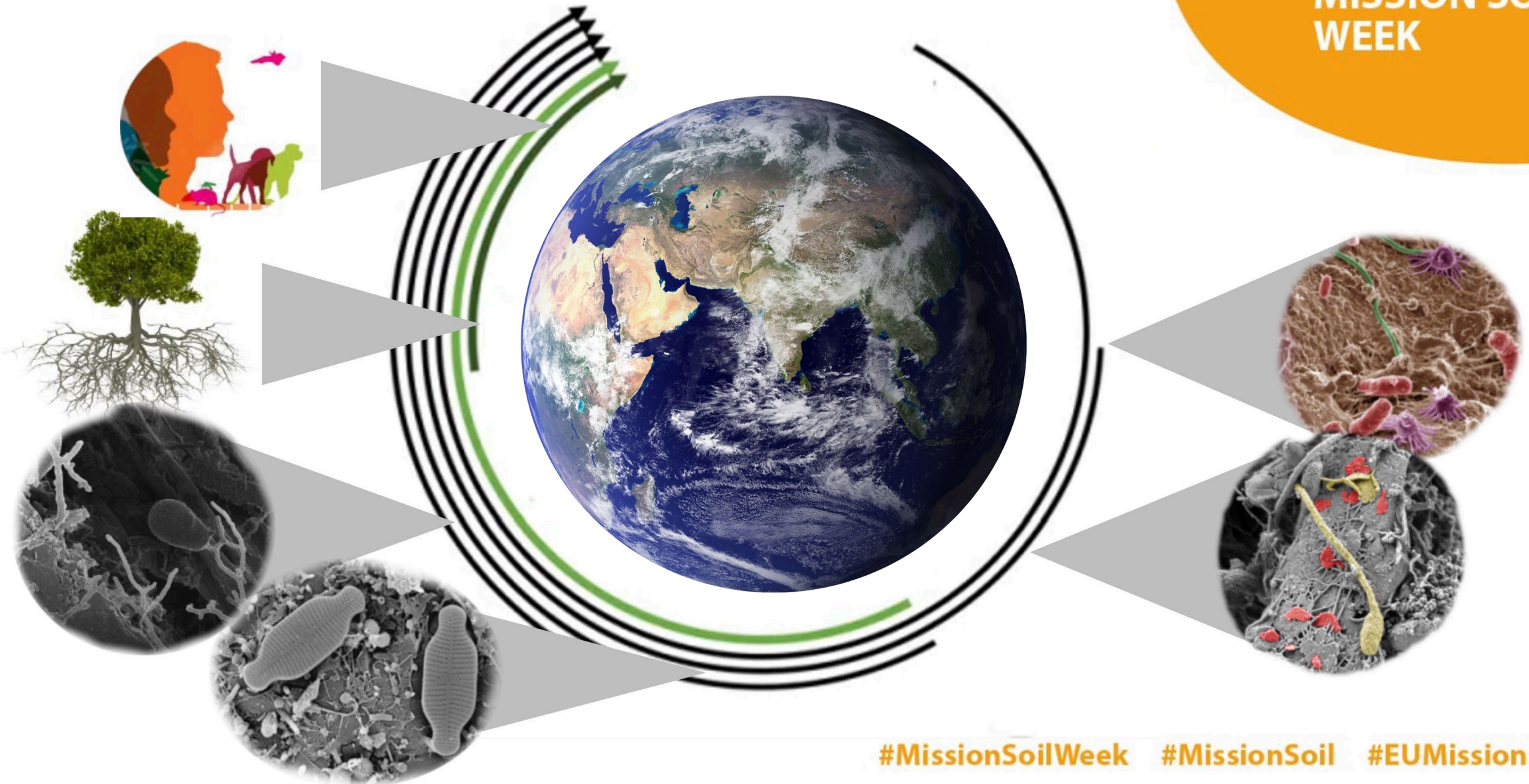
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Soil is home
to ~60%
of the species
on Earth

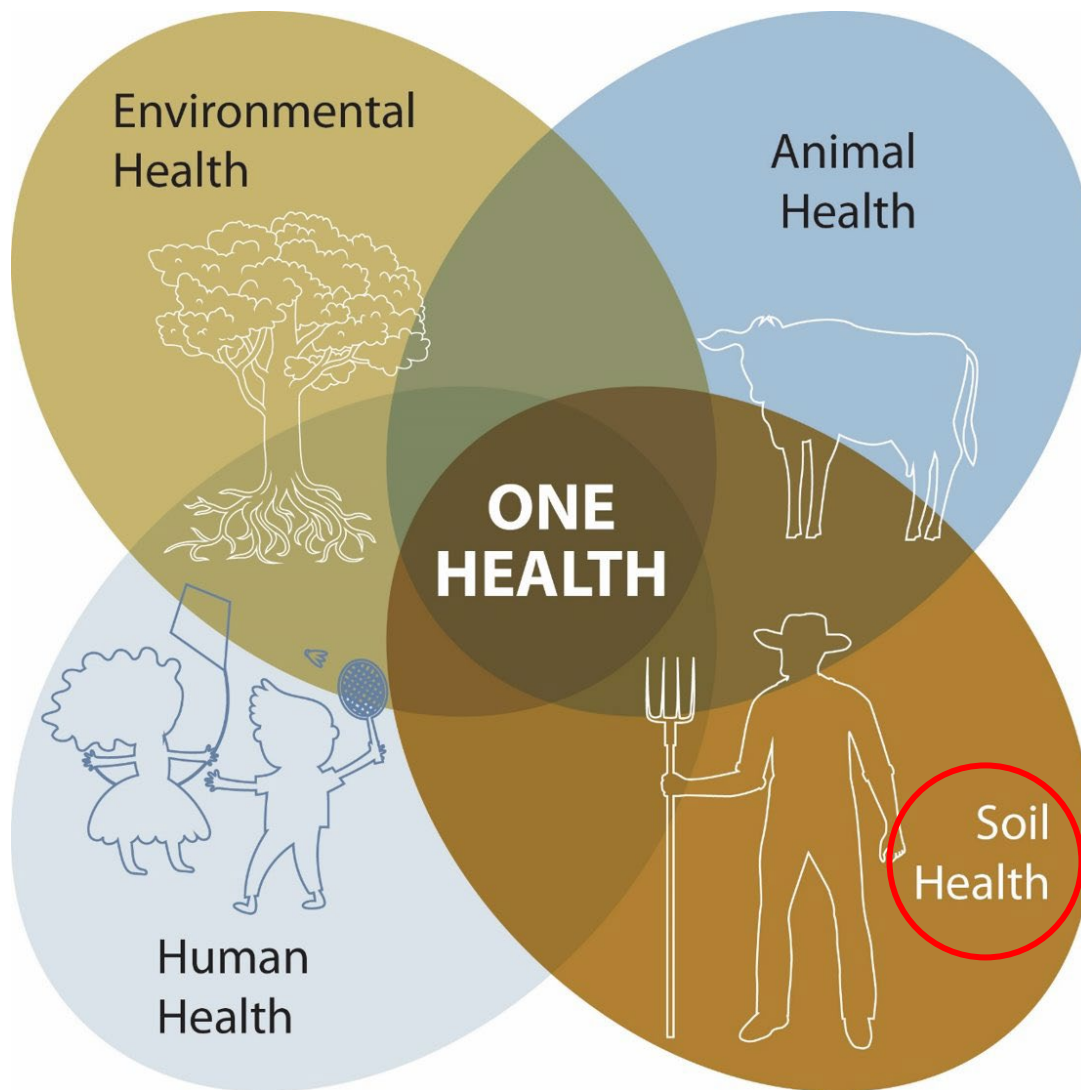


Anthony, M. A., Bender, S. F., & van der Heijden, M. G. (2023). Enumerating soil biodiversity. *Proceedings of the National Academy of Sciences*, 120(33), e2304663120.

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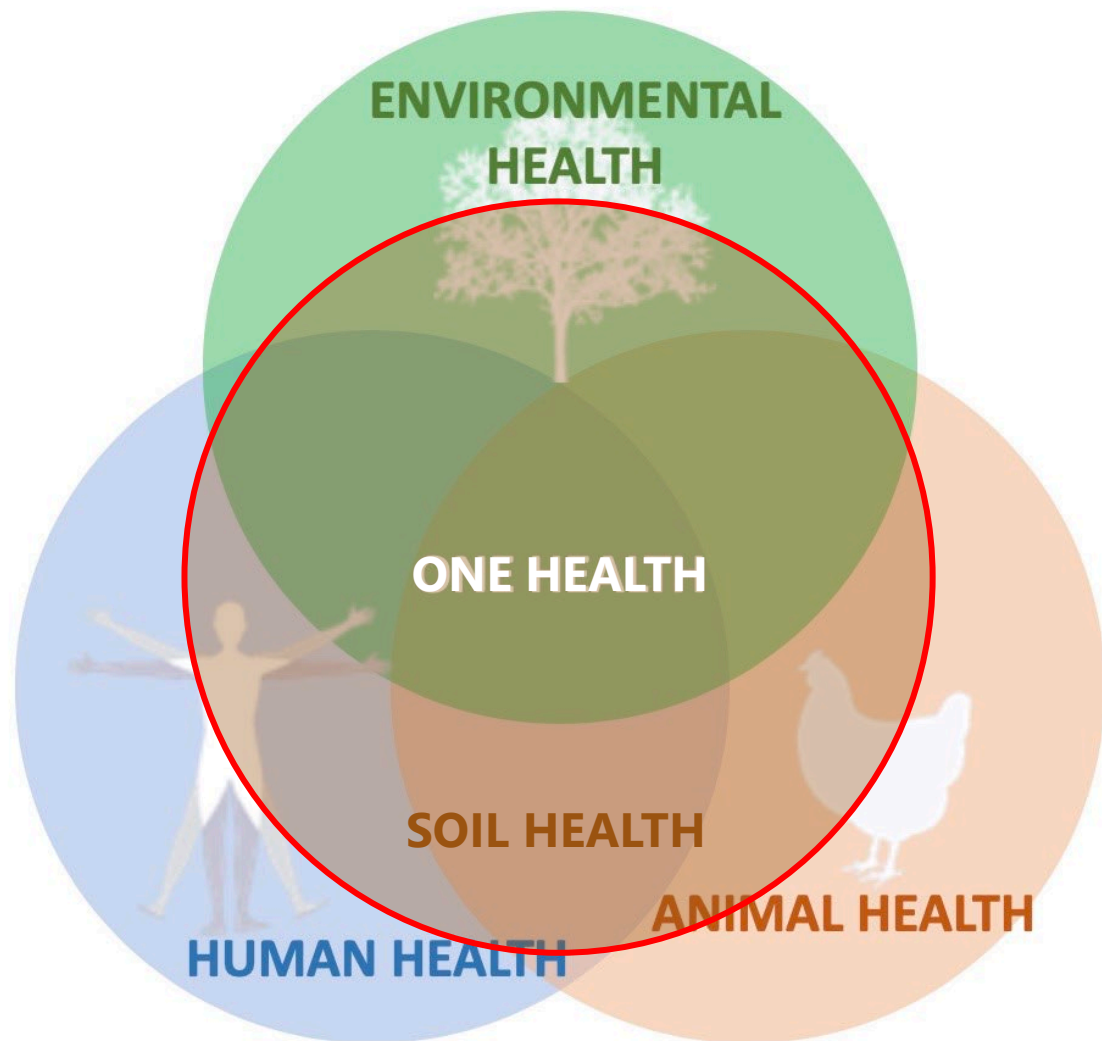


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Soils should be the
foundation of **ONE HEALTH**

A composite image featuring a black microscope on the left, a large reddish-brown soil beetle in the center-right, and a background of white line-art drawings of various soil organisms like worms, nematodes, and fungi. The scene is set on a wooden surface with soil.

Soil Biodiversity should be out of the classrooms and laboratories

Should become
a practical solution
to the issues
we are facing

Science-Policy

Soil Biodiversity cannot be considered a separate discipline from soil science

Soil biodiversity assessment should be part of Soil Surveys

We only know about 1% of soil biodiversity



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**GUIDELINES FOR
SOIL DESCRIPTION**





Convention on
Biological Diversity

Distr.
LIMITED

CBD/SBSTTA/24/L.7/Rev.1
19 March 2022

ORIGINAL: ENGLISH

SUBSIDIARY BODY ON SCIENTIFIC,
TECHNICAL AND TECHNOLOGICAL ADVICE
Twenty-fourth meeting
Geneva, Switzerland, 14-29 March 2022
Agenda item 7

**REVIEW OF THE INTERNATIONAL INITIATIVE FOR THE CONSERVATION AND
SUSTAINABLE USE OF SOIL BIODIVERSITY AND UPDATED PLAN OF ACTION**

SCOPE AND PRINCIPLES

19. **FAO is invited to facilitate the implementation of the plan of action**, and it is intended to align activities on soil biodiversity more closely with other FAO-related activities including the **International Network on Soil Biodiversity** and the **Global Soil Biodiversity Observatory**, to monitor and forecast the conditions of soil biodiversity and soil health as well as with regional and country offices in order to create synergies and provide broader support. The full implementation of the plan of action at the national and subnational levels will depend on the availability of resources.

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International Network on Soil Biodiversity



- **WG 1:** measurement, assessment and monitoring of soil biodiversity.
- **WG 2:** sustainable use and management, and conservation of soil biodiversity.
- **WG 3:** economics of soil biodiversity.
- **WG 4:** policies and legal instruments related to soil biodiversity.

Become a Member of NETSOB



Global Soil Partnership

[Home](#) [Overview](#) [Partners](#) [Regional partnerships](#) [ITPS](#) [Technical networks](#) [Areas of work](#) [Soil Doctors Programme](#) [Resources](#)



International Network on Soil Biodiversity

The International Network on Soil Biodiversity (NETSOB) was established in December 2021 to **promote the sustainable use and conservation of soil biodiversity** and to bring experts in this field and existing initiatives together to form the human talent that contributes to the implementation of the Global Soil Biodiversity Observatory (GLOSOB).

For more information contact: [Jacob Parnell](#) and the [GSP Secretariat](#).

NETSOB functions and duties

- Why a network? +
- Objectives of the NETSOB +
- NETSOB working groups +
- The governance of NETSOB +
- Strategic partners +
- How can I join the network? +

Assess, Monitor and
Forecast status of Global
Soil Biodiversity

WHAT

- Standardized Bioindicators
- Best Practices for Conserving Biodiversity
- National Coordination and Capacity
- Global Database

HOW

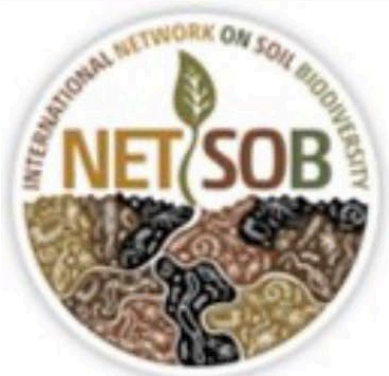
Countries Adopt Standards
and Begin Monitoring
Initiative



GLOBAL SOIL BIODIVERSITY OBSERVATORY

MISSION

Best Information for
Decision-Makers



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Take Home Message

Soils are the foundation of most life on Earth

- Evolutionarily and ecologically linked to soils
- Reliant on soil ecosystem services

Soil Biodiversity Needs to be Central Concept (Mainstreamed)

- Should be foundation of One Health (Planetary Health, EcoHealth)
- Should not be separate from soil surveys

Soil Biodiversity should be a Global Priority

- Join International Network of Soil Biodiversity (NETSOB)
- Contribute to Global Soil Biodiversity Observatory (GLOSOB)



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Thank you!

Email: john.parnell@fao.org

Website: <https://www.fao.org/global-soil-partnership/netsob/en/>



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European Research
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CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS



INIA
Instituto Nacional de Investigación
y Tecnología Agraria y Alimentaria



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**SOB4ES- Spotlight soil biodiversity's
role in ecosystems**

Prof. Maria J. I. Briones

University of Vigo (Spain)



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Integrating **SOil Biodiversity** to **Ecosystem Services**: testing cost-effectiveness of Soil Biodiversity indicators and the provision of soil biodiversity-based Ecosystem Services to build better land management solutions that effectively implement the EU Soil Strategy

This project has received funding from the European Union under the Horizon Europe grant agreement No. 101112831, the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract No. 23.00229, and the UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee [grant number 10079464].



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UK Research
and Innovation

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SOB4ES key objectives:

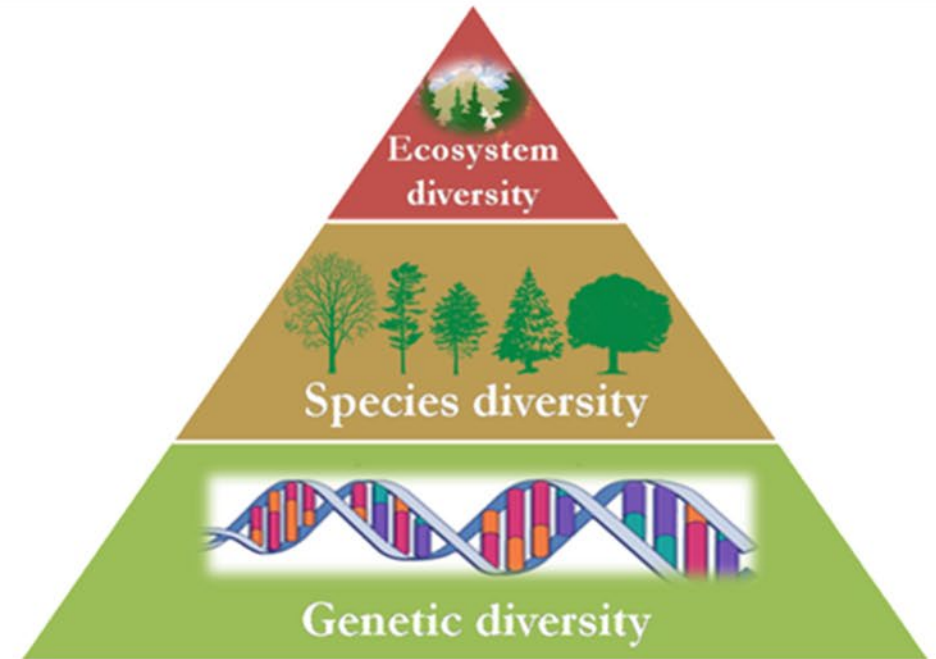
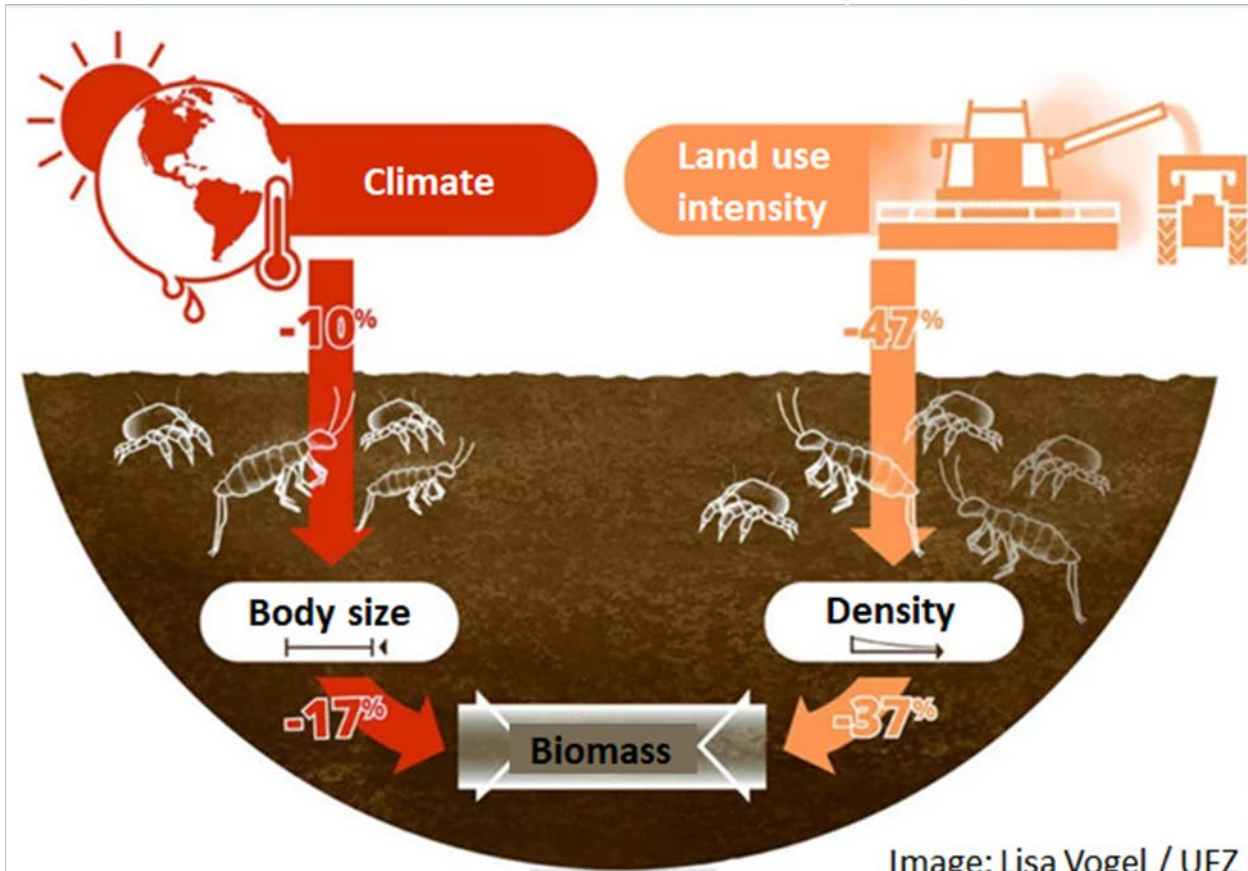
Making soil biodiversity and its contribution to ecosystem services visible to society alongside integration into EU policies

- ✓ To assess soil biodiversity community composition, its spatial and temporal dynamics, linkages with aboveground biodiversity and ecological network structure in response to land use types and intensity
- ✓ To understand the interrelationships between soil biodiversity and ecosystem services for representative land uses and pedoclimatic regions
- ✓ To improve current evaluations of ecosystem condition by incorporating soil biodiversity structural and functional indicators into large-scale monitoring surveys and land management planning
- ✓ To assess soil biodiversity To integrate ecological knowledge of soil biodiversity into the daily life of Europeans (stakeholders, policy-makers and citizens) by interactively exchanging knowledge, raising public awareness and societal appreciation of the vital functions of soil biodiversity and its contribution to ecosystem services

WP2

Soil biodiversity analysis under various intensities of major land uses in pedoclimatic regions representative for the EU

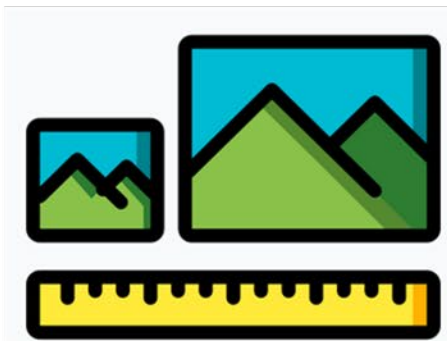
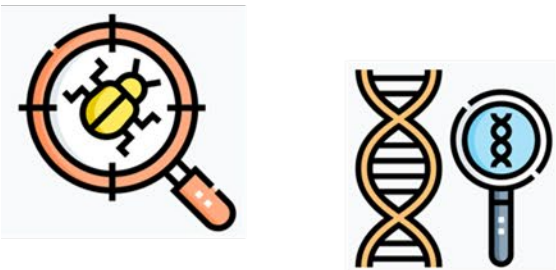
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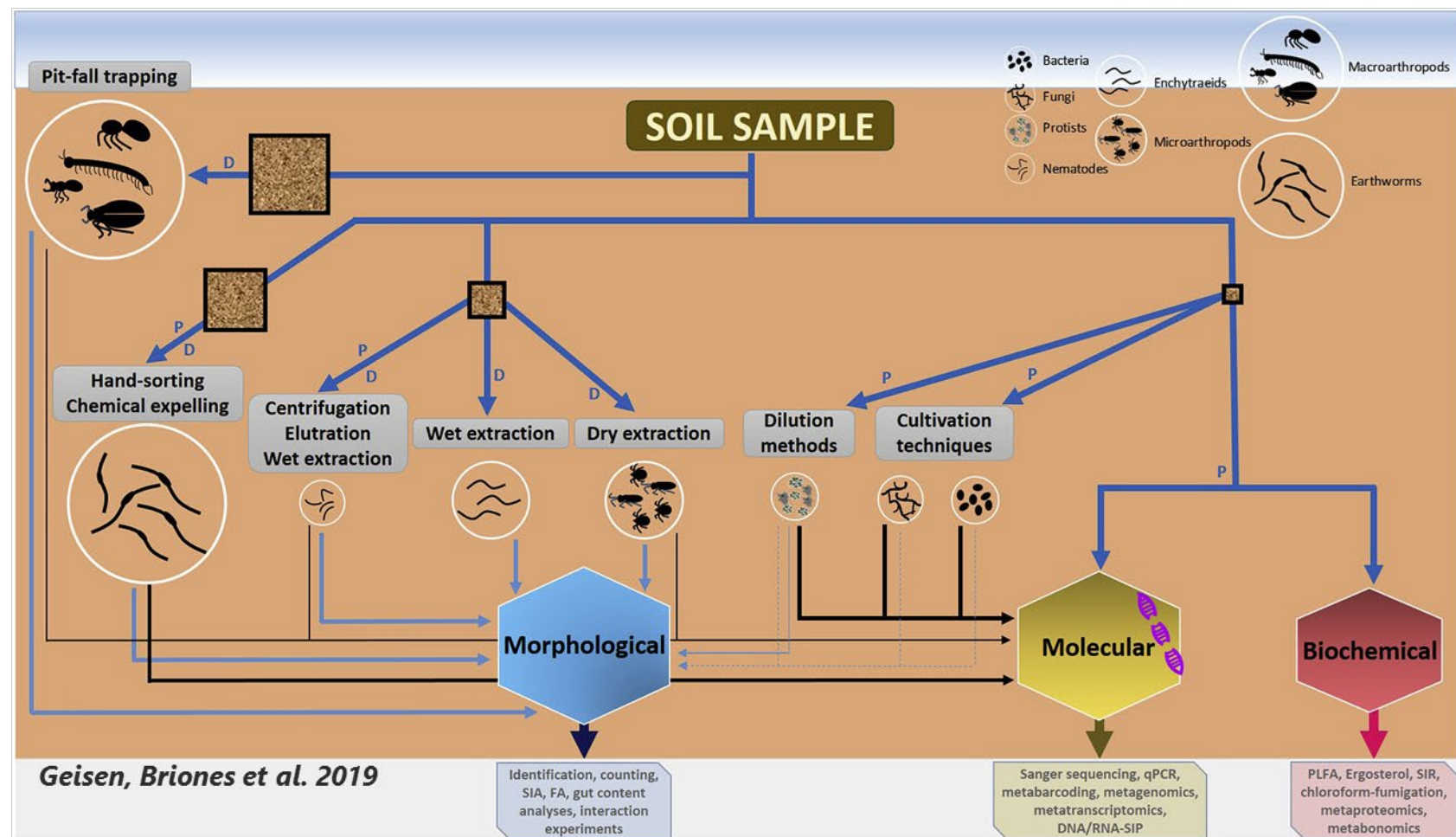
Taxonomical, genetic (including both RNA and DNA sequences, together with functional genes), Trophic diversity of a wider range of soil organisms (from micro- to macro-fauna)

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Challenges



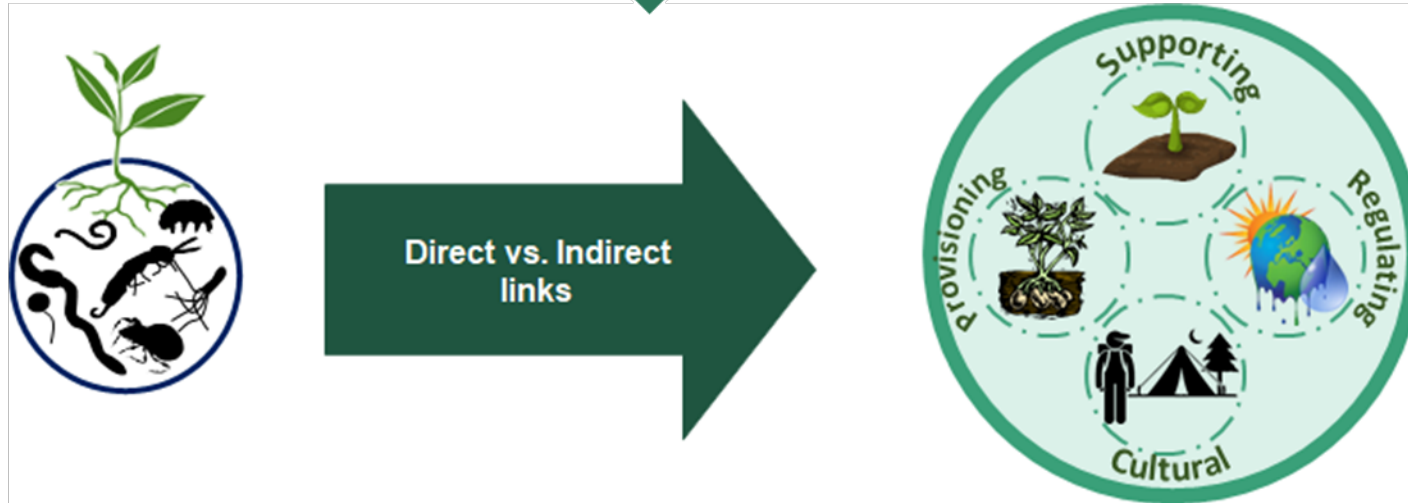
- ❑ Soil biodiversity metrics
- ❑ Methodological constraints
- ❑ Spatial and temporal scales
- ❑ Metadata
- ❑ Comprehensive databases



WP3

Understanding how to link soil biodiversity and ecosystem services across different land use intensities and pedoclimatic regions

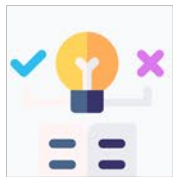
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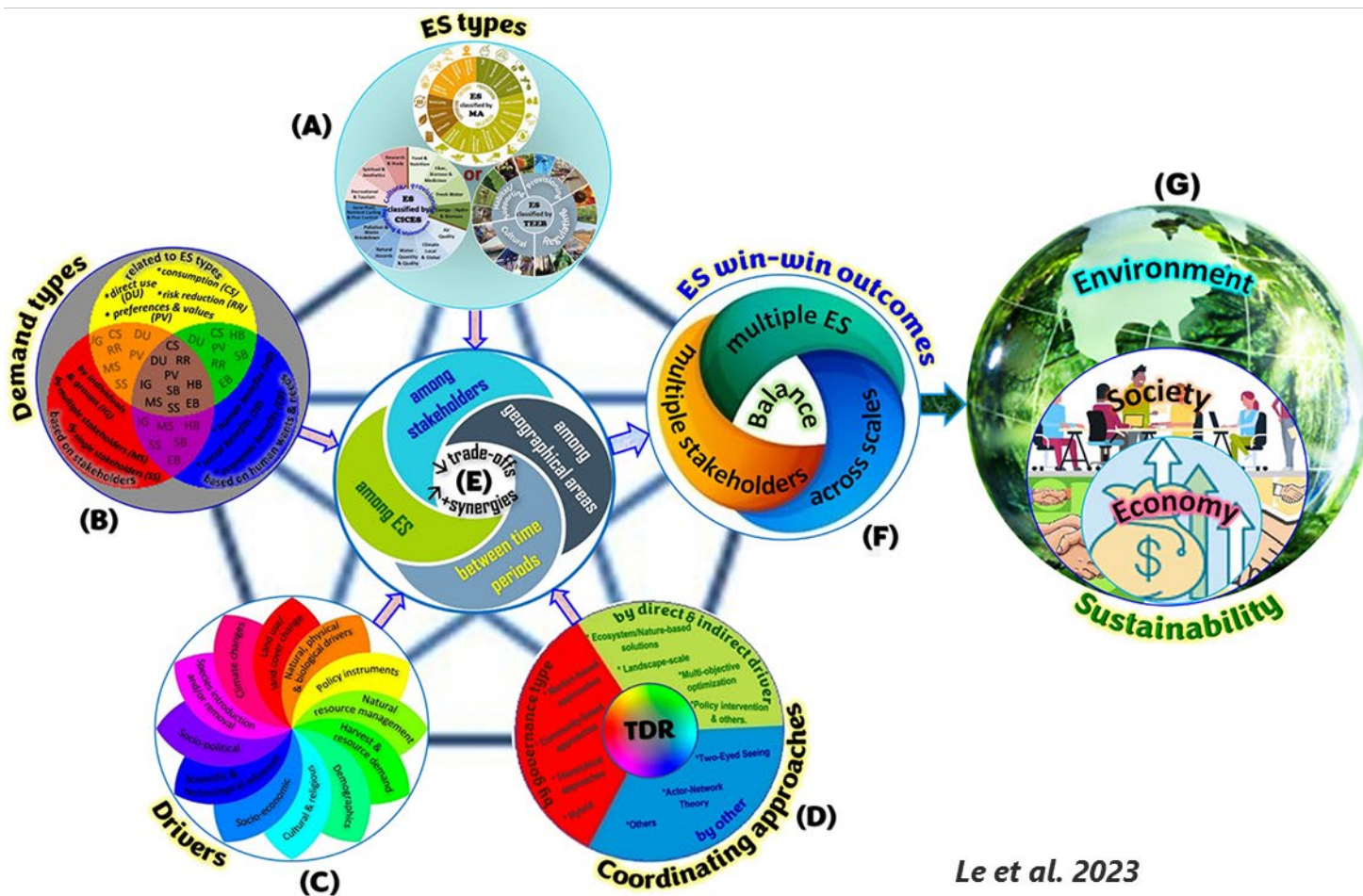
Interrelationships between soil biodiversity and ES for representative soil types, land uses and pedoclimatic regions

Extent to which drivers of change and pressures (including their interactions) affecting soil biodiversity could impact soil functions and ES

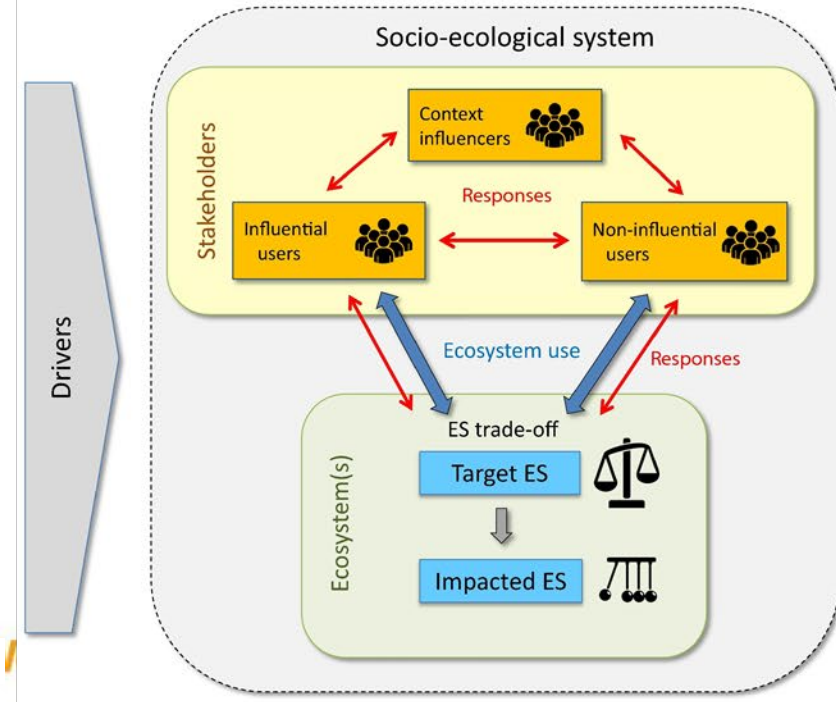
Challenges



- ❑ Direct vs. indirect links
- ❑ Quantitative metrics
- ❑ Interactions (synergies & trade-offs)
- ❑ Demand/interest

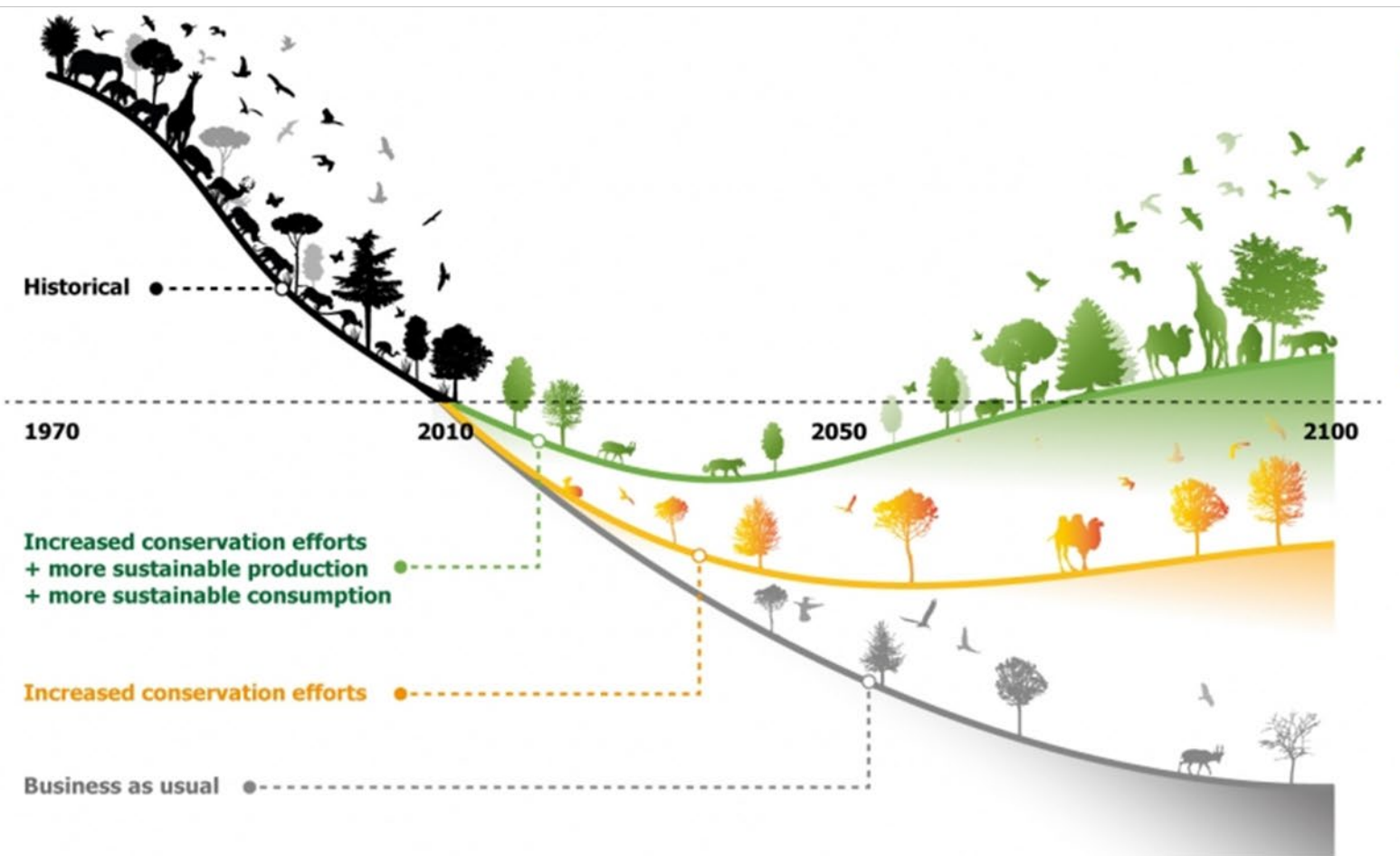


Turkelboom et al. 2023



Potential practices for improving soil biodiversity

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This artwork illustrates the main findings of the article, but does not intend to accurately represent its results (<https://doi.org/10.1038/s41586-020-2705-y>)

Test which land management actions have the highest potential capacity to enhance the delivery of ecosystem services in a particular ecosystem type/land use

Increase the uptake of practical applications to enhance soil biodiversity and its contribution to ecosystem services

WP5

Making soil biodiversity and its contribution to ecosystem services visible to society alongside integration into EU policies

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Knowledge exchange
and integration in
management
practices

Proposing legal-
binding instruments
that address SOB
protection explicitly

POLICY

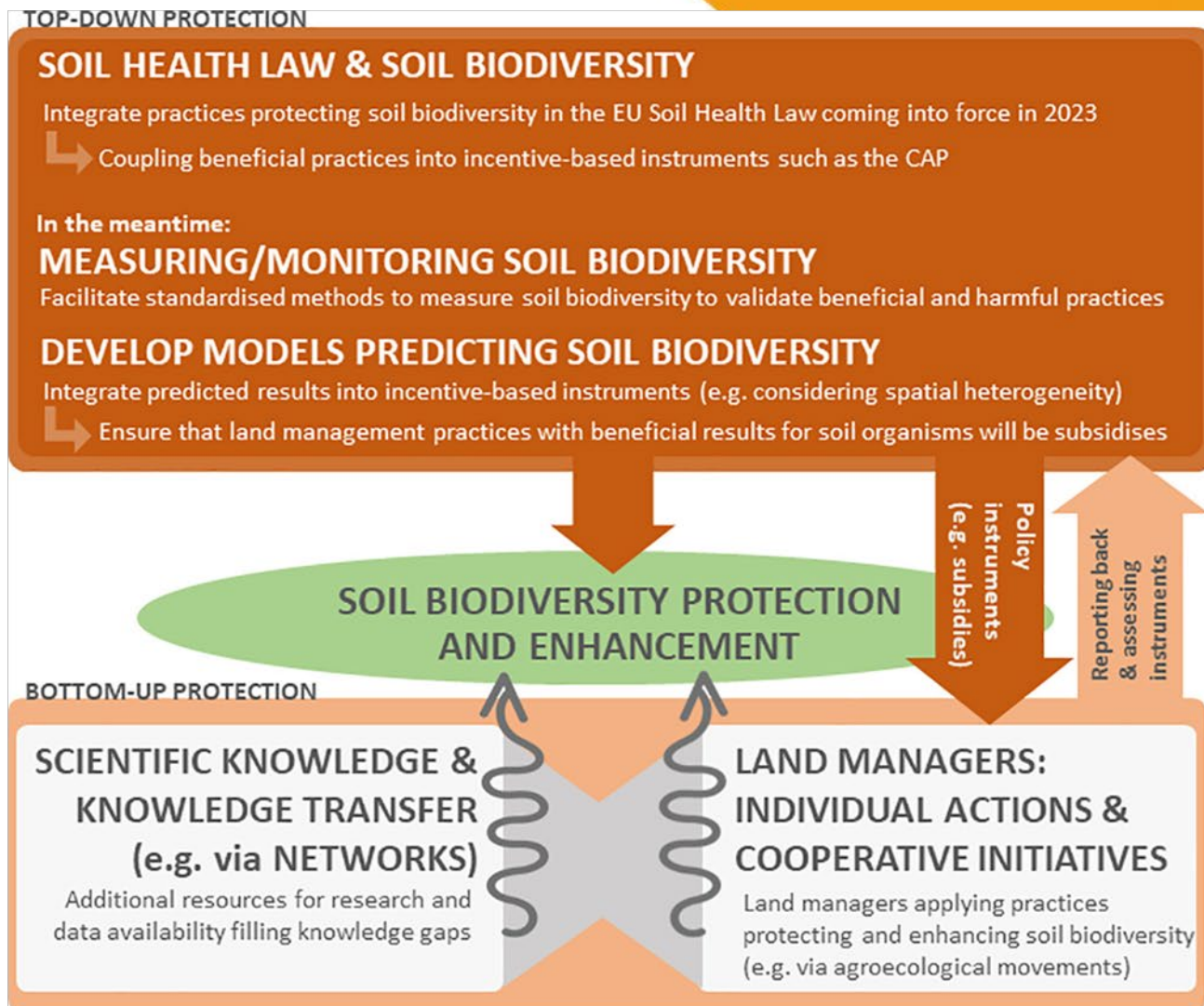
More targeted policy
incentives to
conserve/restore soil
biodiversity



Ensure scientific and
practical knowledge
transfer

Challenges

- ❑ Incentives for beneficial land use practices
- ❑ Joint action at the EU level rather than at MS level
- ❑ Compulsory rather than voluntary approaches
- ❑ Regulatory instruments such as fines, loss of payments or reputation as potential consequences of non-compliance





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Thank you!



Email: mbriones@uvigo.gal

Telephone: [+34 986812584]

Website: www.sob4es.eu

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@EUAagri



@EUAagri
@EUgreenresearch



@euagrifood



European Research
Executive Agency (REA)



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E INNOVACIÓN



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CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS



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y Tecnología Agraria y Alimentaria





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From Traditional Soil Degradation to Soil Conservation by Understanding Soil Biodiversity - The Case of Annual Crops

Gerard RASS - GCAN – Global Conservation Agriculture Network
APAD – Association pour la Promotion d'une Agriculture Durable

22/11/2023



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ASSOCIATION FOR THE PROMOTION OF SUSTAINABLE AGRICULTURE

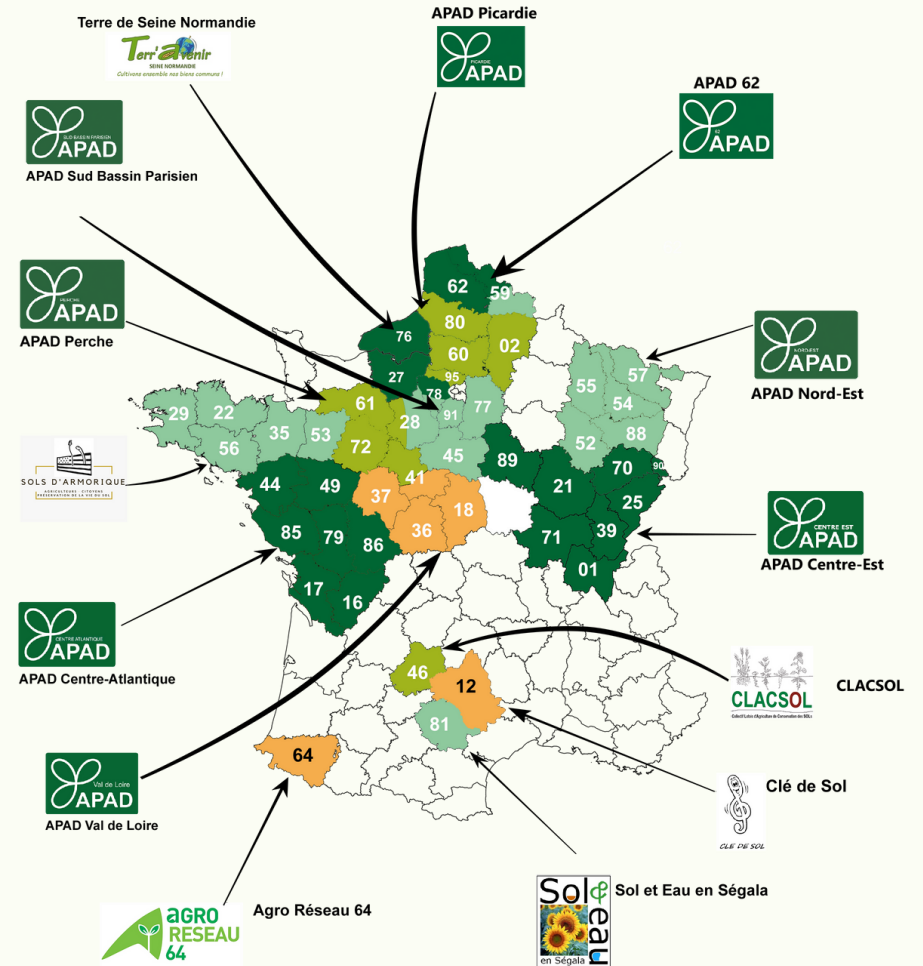
A network of **14** associations of farmers in France
1000 farmers
100% volunteer farmers

Member of international networks

GCAN : Global conservation agriculture network

ECAF : European Conservation Agriculture Federation

4P1000 / GSP



Summary

**Impacts of Traditional Farming Practices on Soils ,
with focus on Biodiversity**

Farming Systems which enrich our Soils, thanks to Biodiversity

Difficulties met by Farmers to implement Conservation Farming

How to overcome the barriers

Traditional Practices : how the Plough « makes a structure »



To break the clods, the most efficient is rotative hoe : it makes fine soil = dust



Soil exposed to sun and rain

Soil Loss, Run-off, Pollution, Eradication of Biodiversity...



Impact of practices on Soil, Water, Biodiversity...

... CROPS

Erosion, run-off, pollution :

- soil particles,
- nitrates,
- phosphorus,
- pesticides...



Farming Systems which improve our Soils are based on Biodiversity

Foresters tell us that without them there will be no Forest.

Hunters tell us that without them there will be no Wildlife.

Farmers believe that without them there will be no Vegetation.

But Forest, Wildlife, Vegetation, existed before Humans.

Nature does not leave bare Soil. Nature does not break the Soil

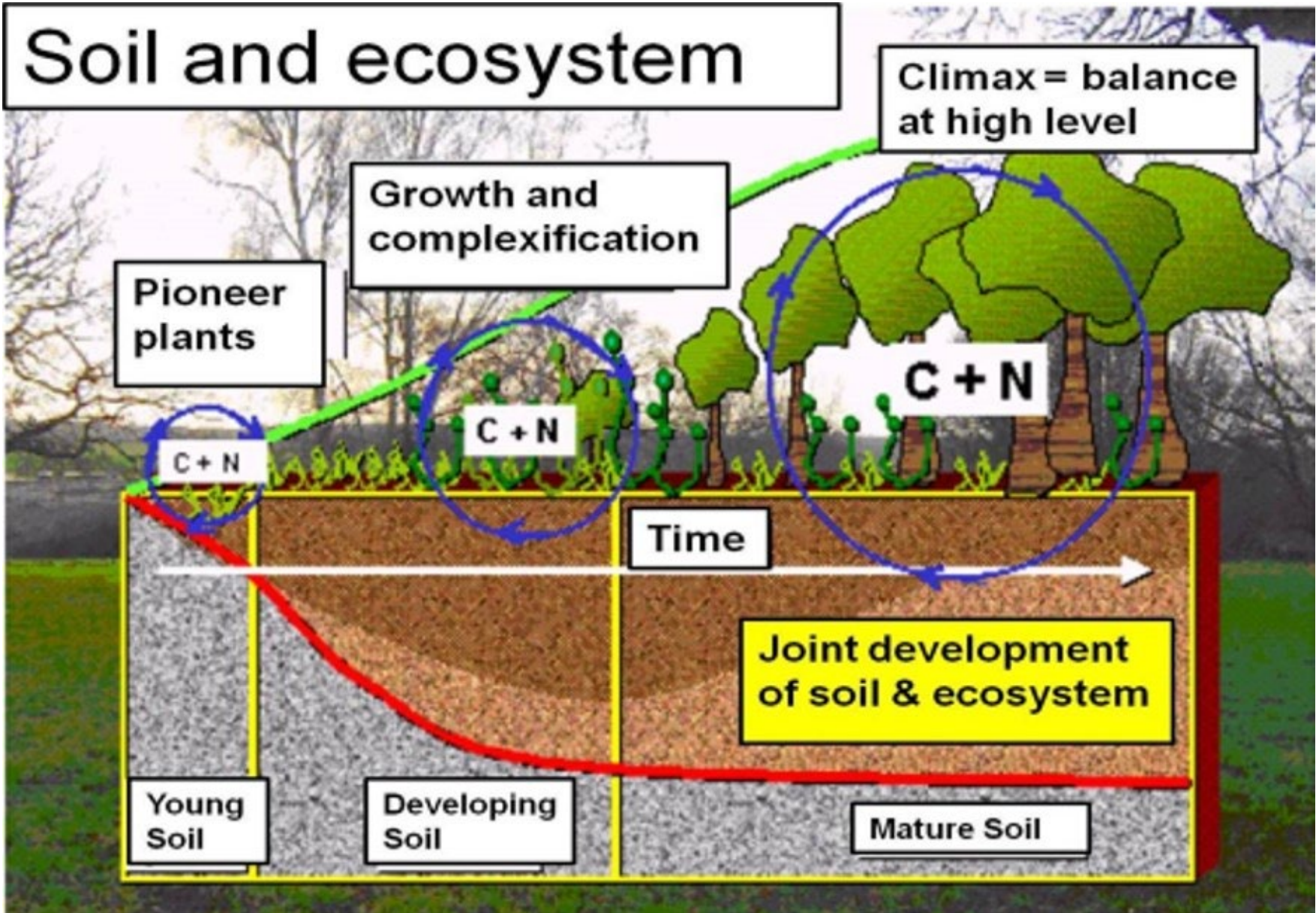
Nevertheless Natural Ecosystems with no input, can produce much more Biomass /ha than any Farmer.

If we can Mimic them, perhaps we can improve the Sustainability of Farming Ecosystems.

This new paradigm has been invented in Southern countries, where Farmers had no inputs, where Intensive Rains made Mechanized Cereal Agriculture impossible with Tillage.



Soil and ecosystem



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Evolution
of
Natural
Ecosystem:
produce MORE

What does Agriculture do to Ecosystems ?

1. First we remove the vegetal cover :
clearing :
 - **Slash / Burn**
 - **Deforestation**
 - **Grazing**
2. Then we break the soil : hoe, plough, tillage...



From a Forest to a steppic Area



**Human Actions
on
Natural
Ecosystem:**

**reduce Biomass
produce LESS**

**reduce
Biodiversity**

- Which one produces more biomass ?
- Which one gives back more biomass to the soil ?
- Which one maintains better SOM and soil biology ?

Tillage is the Killer of Soil Biodiversity by destroying its Habitats & Trophic Chains

SOIL TILLAGE DESTROYS BIOLOGICAL AND ECOLOGICAL
INTEGRITY OF SOIL SYSTEM



Maximum disturbance, killing living organisms



Before first
tillage



After first
tillage



After second
tillage

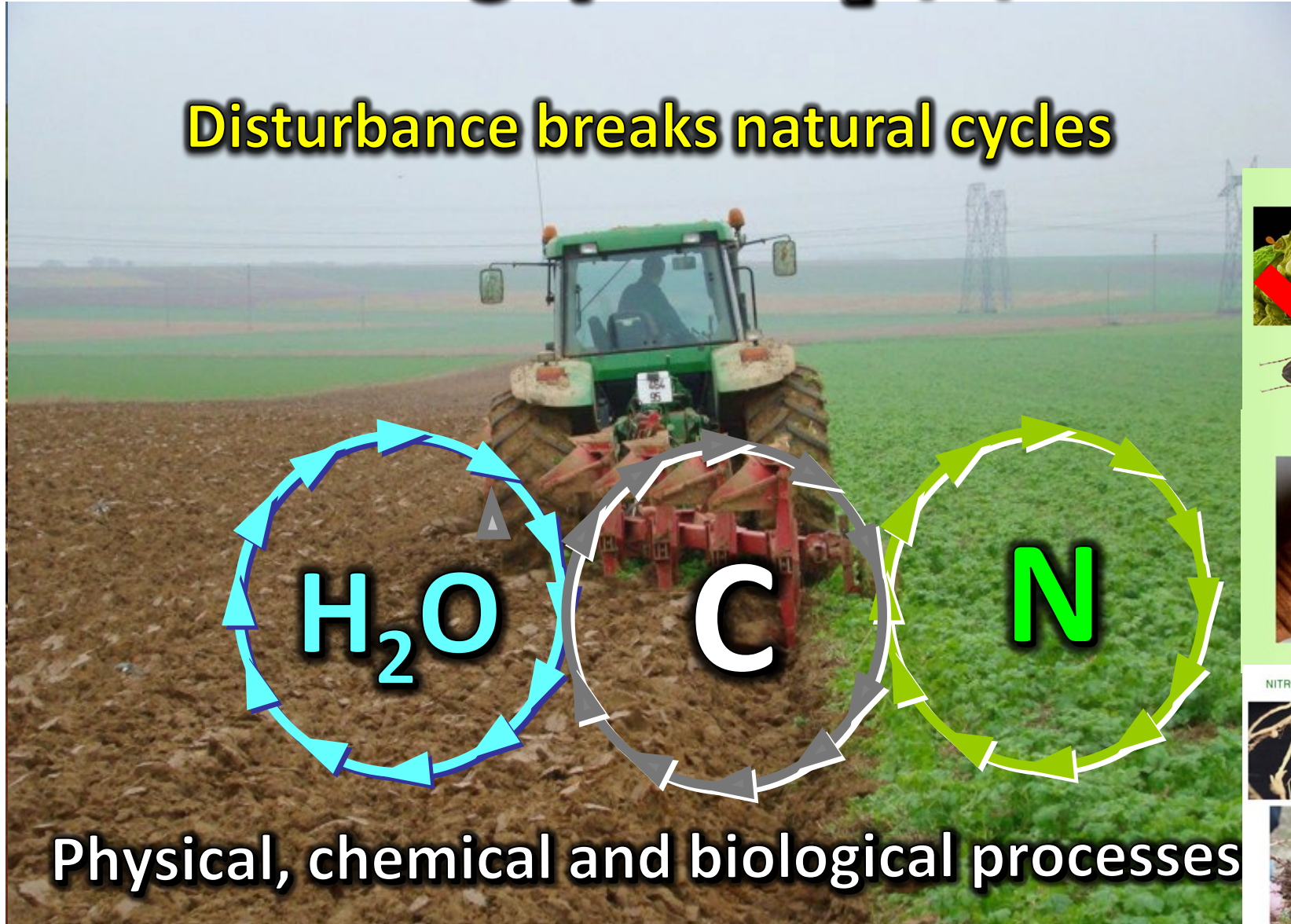


Interacting cycles : H₂O, C, N



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Disturbance breaks natural cycles



ARTHROPODS & MICRO ARTHROPODS

La faune du sol se développe dans un univers stable et protégé

IN THE SOIL LIVE BILLIONS OF ORGANISMS

- 250,000,000 bacteria
- 100,000 protozoa
- 1,000,000,000 bacteriophages
- 5 kms hyphae
- 500 beneficial nematods
- 15,000,000 bacteriophages

THE SOIL IS A HOUSE BUILT FROM RECYCLED MATERIAL

NITROGEN-FIXING BACTERIA : THE FERTILIZER FABRIC

Soil fertility / productivity
SOM = C + N / nutriments+ H₂O

Biological
Physical
Chemical
Hydrological

B Cl P K H
Cu Fe Ca O
Mn Mo Zn S

Physical, chemical and biological processes

Don Reicosky

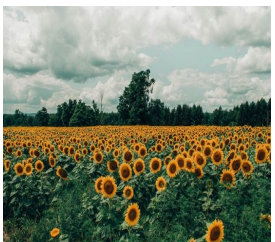
Conservation Agriculture: 3 pillars



1
No tillage – Direct seed
Soil aeration is achieved through soil structure and undisturbed soil life



2
Permanent soil cover
Crop residues, plant cover, emphasize photosynthesis



3
Plant diversity
In the rotation of main culture and in the cover crops
Using plants with important biomass (more C from the atmosphere)
Using legumes that fix nitrogen from atmosphere
Using plants for their services

Conservation Agriculture:
defined by FAO
3 pillars in synergy and indissociable



Iterative system, virtuous spiral based on results

- <http://www.fao.org/conservation-agriculture>
- [Successful Experiences and Lessons from Conservation Agriculture Worldwide. Amir Kassam, Theodor Friedrich and Rolf Derpsch. Agronomy 12. 2022.](#)



Conservation Agriculture

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**Highest
Biomass**

**Highest
Biodiversity**

**Highest Soil
Fertility**

Highest Yield



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Drivers & Difficulties of Farmers To Implement CA

Farmers like CA when they see

- High Yielding Crops, Fertile Soil
- Labour productivity, Profit for their family

Farmers need

- To see CA working well on farm
- Know-How transmitted by their colleagues
- Answers to technical /scientific questions
- Access to Water (dry areas)
- Access to Machinery, Seeds, Fertilizers, Pesticides...
- Freedom to innovate and adapt (low bureaucracy / taxes)
- Recognition from Society

FARMERS ASSOCIATIONS

SCIENTISTS

POLICIES

European CAP does not support Soil Conservation & encourages Tillage

Farmers get subsidies for this
(Conventional or Organic)

Conventional (95 % of annual crops in Europe)



No support for CA
challenged as non Organic

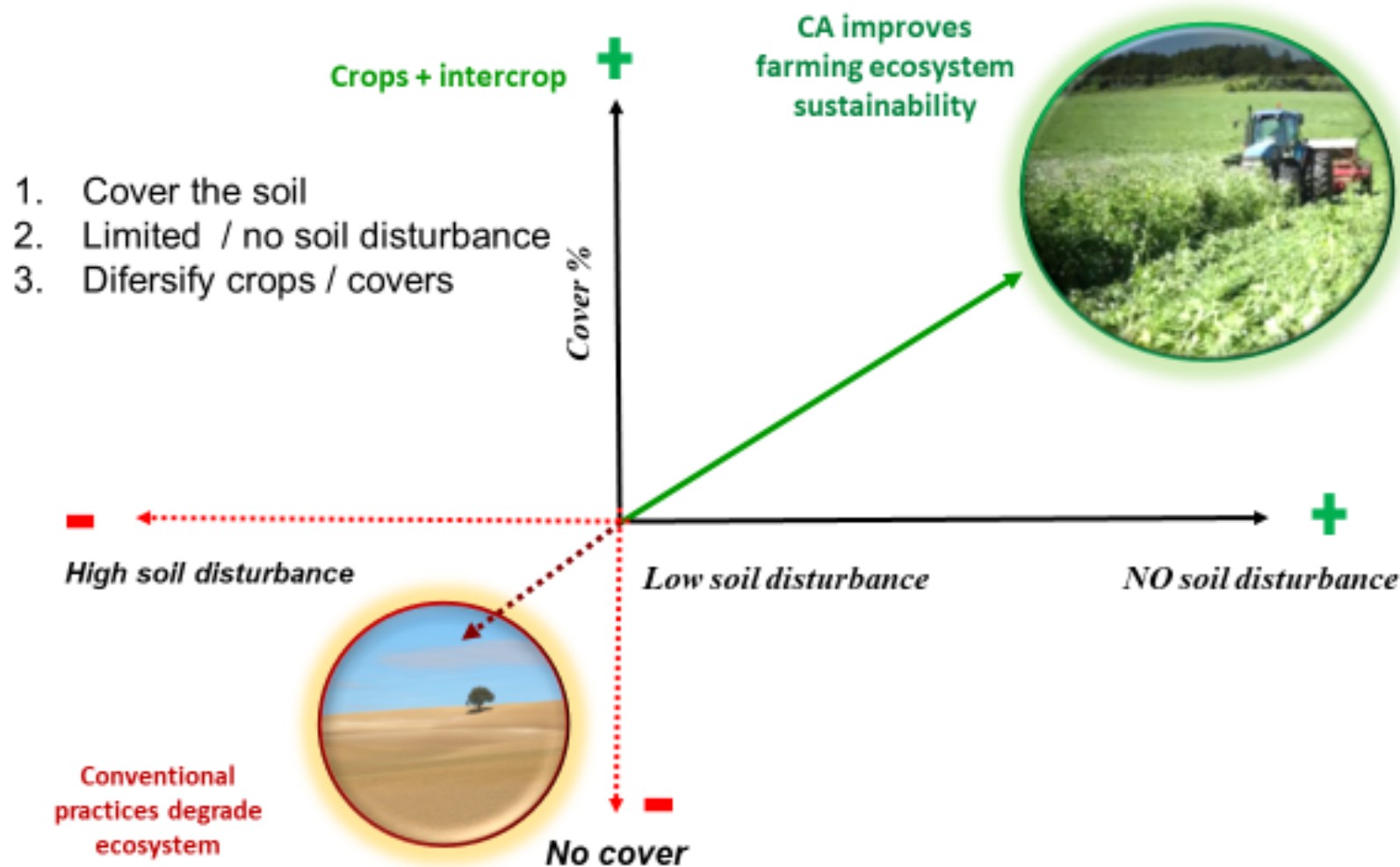
Conservation Agriculture (4 % annual crops in Europe)



HOW TO EVALUATE WHERE WE ARE, THE PROGRESSES MADE ?

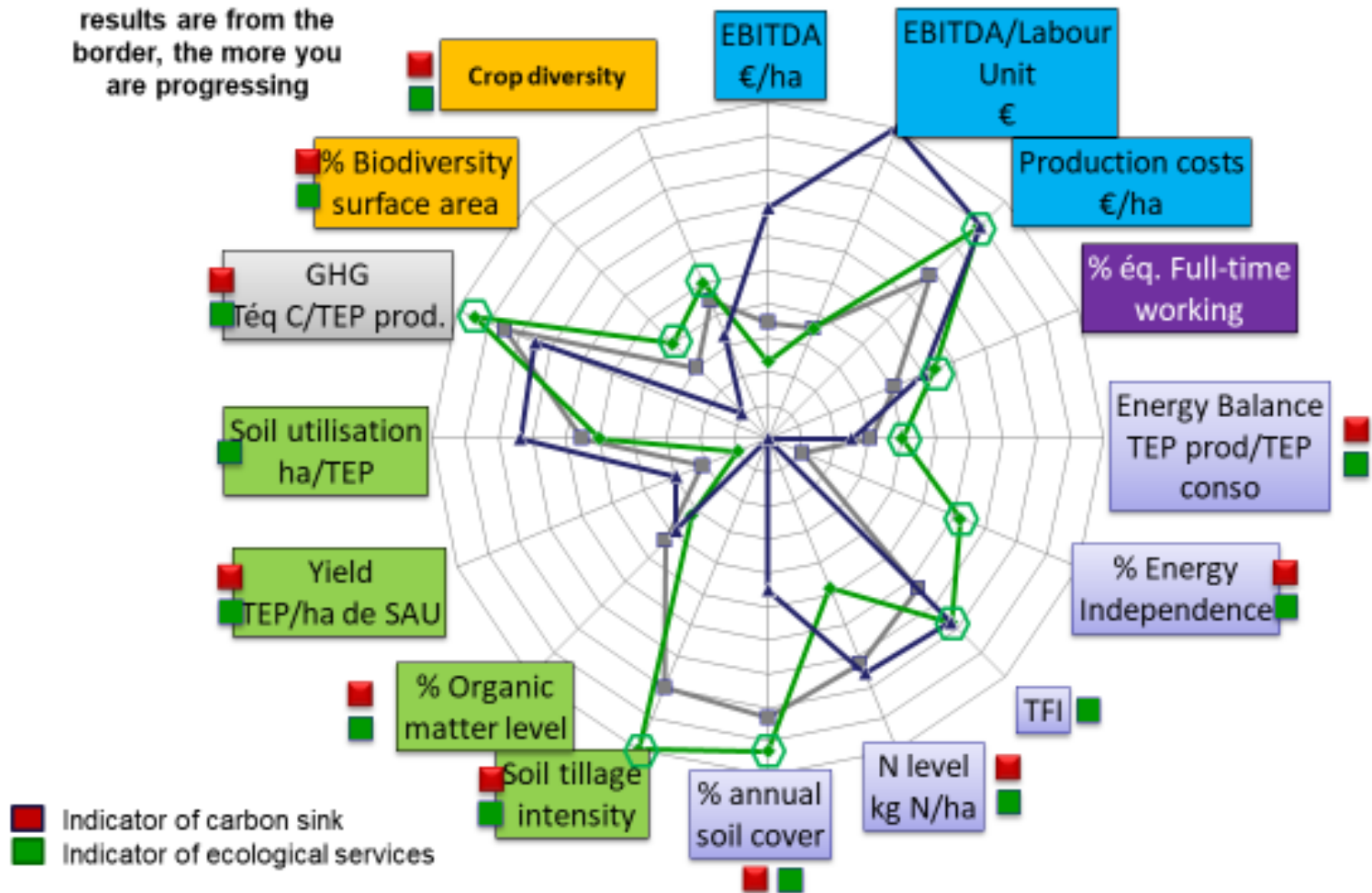
- Indicators on farm, for farmer
- Results driven
- Reflecting the model of high ecological performance and sustainability
- Easy to use
- Available on a web site

PRINCIPLES TO IMPROVE FARMING ECOSYSTEM



INDICATORS OF SUSTAINABLE AGRICULTURE

The nearer the results are from the border, the more you are progressing





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Thank you for supporting Farmers to make the Earth a better place to live !

Email: rass.gerard@icloud.com

Phone Whatsapp : +33 6 45 29 16 51

Website: www.apad.asso.fr



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@EUgreenresearch



@euagrifood



European Research
Executive Agency (REA)

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Panel discussion

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Alberto Orgiazzi

Research Consultant

*European Commission, Joint
Research Centre*



Jacob Parnell

Soil Biodiversity Specialist

*Food and Agriculture Organization
of the United Nations*



Maria J. I. Briones

Professor of Zoology

University of Vigo (Spain)



G erard Rass

General Secretary

*Association for the Promotion of
Sustainable Agriculture (APAD)*

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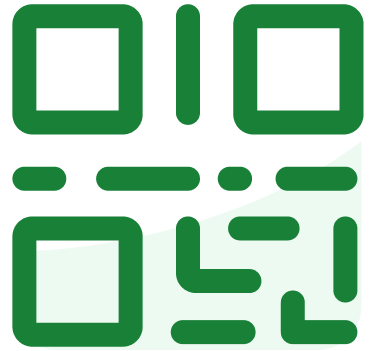
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Q&A

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#ESMW2023**

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Audience Q&A Session

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What are the main gaps for efficiently promoting the implementation of sustainable farming practices that contribute to soil biodiversity?

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How can the Mission Soil meet those requirements?

ⓘ Start presenting to display the poll results on this slide.



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EUROPEAN MISSION SOIL WEEK

Programme Day 2 - Wednesday, 22 November

| Time | Session Name | Building name |
|---------------|---|--|
| 9:30 – 10:00 | Social, economic, and cultural transformations for soil health | <i>Main hall – Building A</i> |
| 10:00 – 11:00 | PREPSOIL project: supporting the Mission Soil | |
| 11:00 – 11:30 | Coffee Break | |
| 11:30 – 13:00 | Breakout session 4 - Soil needs in PREPSOIL regions: engaging with multiple actors | <i>ICA Institute - Building C</i> |
| | Breakout session 5 – Knowledge transfer to farm advisors | |
| 13:00 – 14:00 | Lunch Break | <i>Main hall – Building A</i> |
| 14:00 – 16:00 | Breakout session 6 - Living Labs and other experiences from placed-based innovation | <i>Blas Cabrera Institute - Building B</i> |
| | Breakout session 7 - Soil biodiversity | <i>ICA Institute - Building C</i> |
| | Breakout session 8 - Business models for soil health | <i>Press Room - Building D</i> |
| 16:00 – 16:30 | Coffee break | <i>Main hall - Building A</i> |
| 16:30 – 16:45 | Reporting from breakout sessions | |
| 16:45 – 17:30 | The Mission's regional and local dimension | |
| 17:30 – 18:15 | Mission Manifesto and Mission Ambassadors | |
| 18:15 – 19:00 | Cocktail & Networking | |



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Coffee Break (Main Hall – Building A)

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