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# Microbiome Biobanking: The missing link

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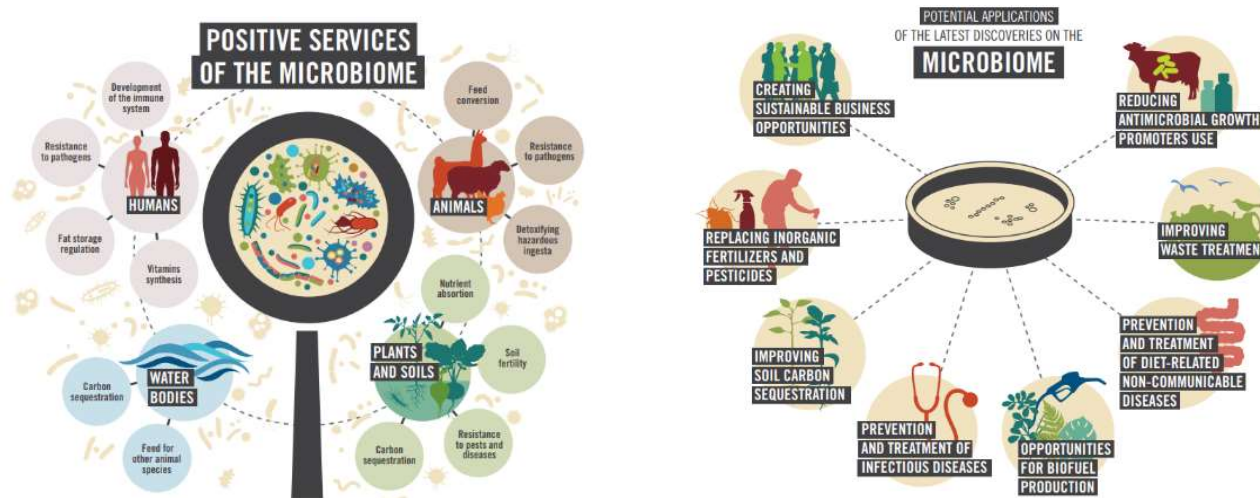
This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101094353

# Why microbiomes?



Microbiome-based innovations can address a range of societal challenges and support transition to a sustainable future

- FAO, 2019, <http://www.fao.org/3/ca6767en/CA6767EN.pdf>
- EC, 2020, <https://data.europa.eu/doi/10.2777/43279>
- d'Hondt et al., 2021, <https://doi.org/10.1038/s41564-020-00857-w>
- Callens et al., 2022, <https://doi.org/10.3389/fsufs.2022.1047765>



Microbiome services & potential applications  
FAO, 2019

# The need for microbiome biobanking



R&I

- More insight into the complex interactions between microbiomes, hosts and other biota enabling knowledge-based solutions
- **Protection of natural resources, including microbiomes**
- International collaboration
- **Big data to be used for precision applications (AI)**
- Smart microbiome-fit application technologies and approaches
- Realistic expectations
- Regulatory environment tailored to address potential risks of microbiomes but enabling rapid approval
- Microbiome literacy in society and a mindset open for microbiome innovations

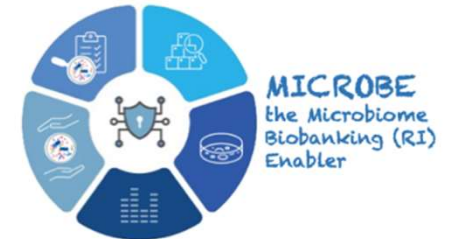
MicrobiomeSupport aims to see microbiome products & applications in use that support the transition to a future-proof food system in line with FOOD2030 priorities.

- OUR VISION -

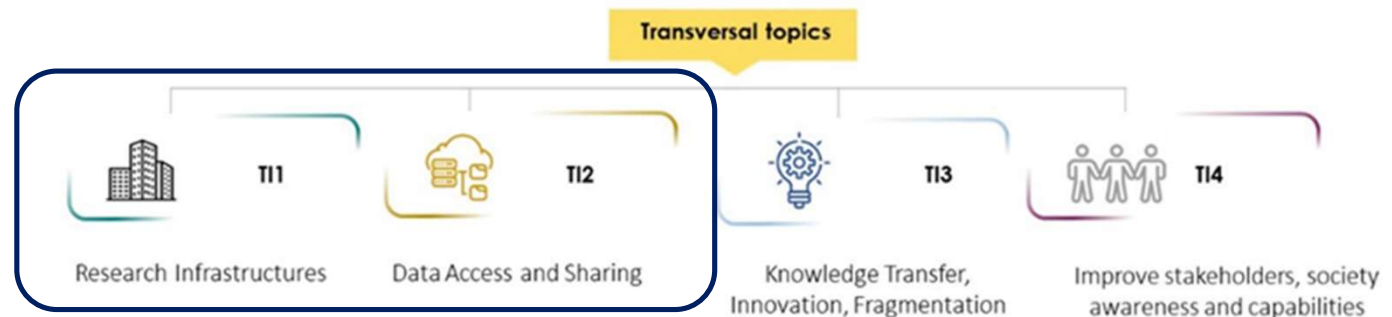
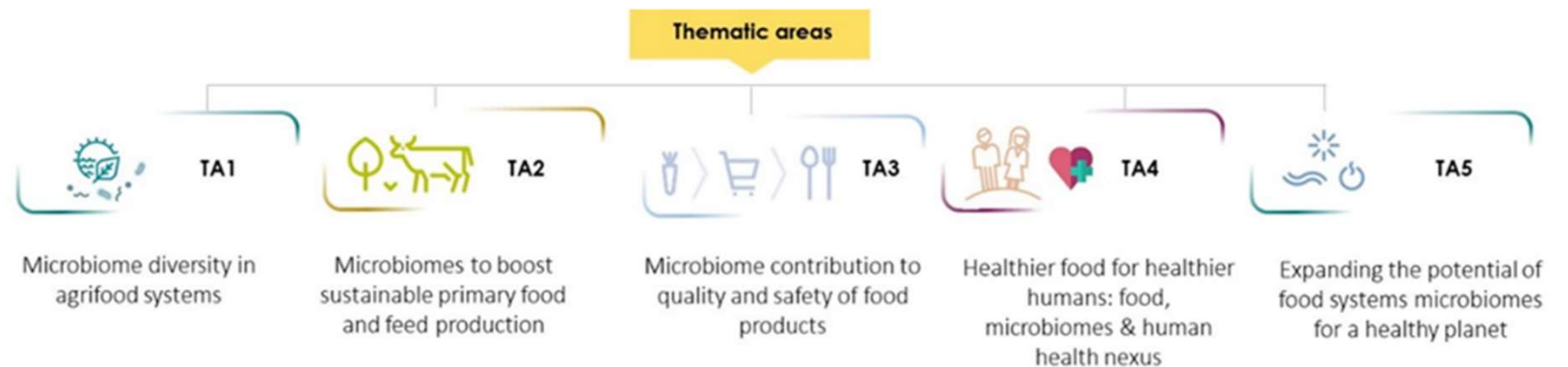


Impact

# The need for microbiome biobanking



<https://www.microbiomesupport.eu/reports/>



# Why MICROBE?



“Biobanking infrastructure is fragmented and not prepared for the biobanking of microbiomes.”



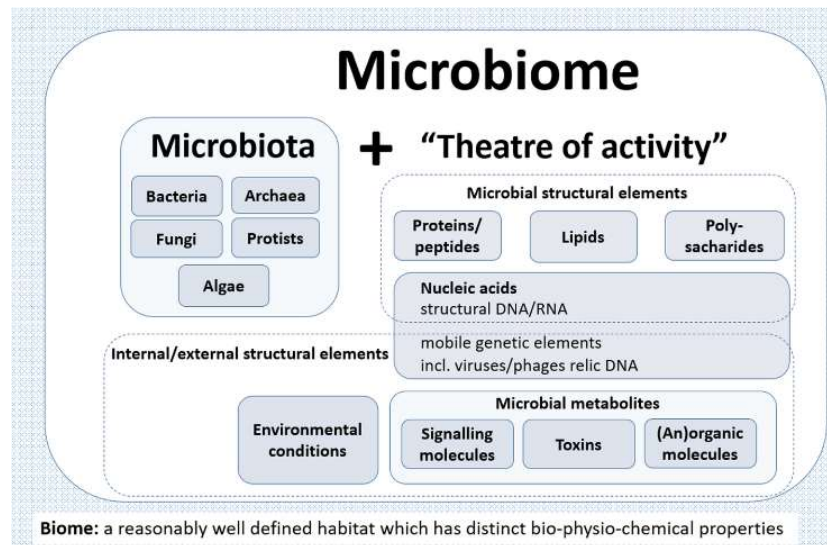
“The biggest technological bottleneck is the development of optimized methodologies for the preservation of microbiomes and for the assessment of preservations’ success in terms of maintaining the composition and functionality of microbiomes.”

Ryan et al., 2020, <https://doi.org/10.1016/j.tim.2020.06.009>

# Key considerations



## Complexity of the microbiome



Composition of the term microbiome

Berg et al., 2020

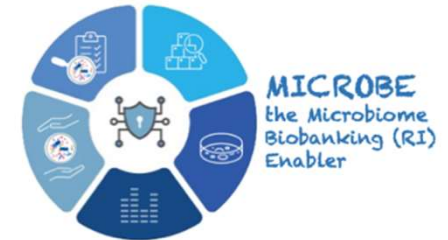
<https://doi.org/10.1186/s40168-020-00875-0>

## Biodiversity

- Ecosystem diversity
- Species diversity
- Genetic diversity



# Key considerations



## What should be preserved?

- Cultured, axenic isolates
- Environmental samples
- Synthetic communities  
(taxonomic/functional representation of the natural microbiomes)
- gDNA / RNA / protein extracts / metabolic fractions

How can we access it (targeted isolation)?

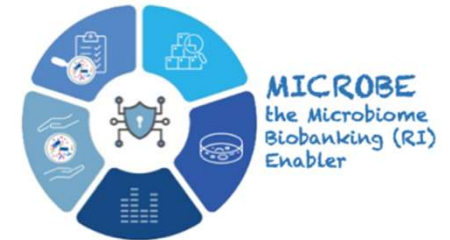
What is the best way of preserving it?

How to assess compositional and functional integrity?

How to ensure harmonisation and linking of (meta)data with biological sample(s)?

Who should have access to samples and data?

## Knowledge gap



“If you try and take a cat apart to see how it works, the first thing you have on your hands is a nonworking cat”

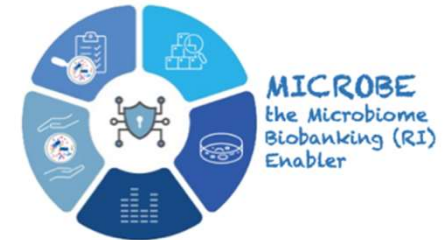
D. Adams



Jakob  
© I. Hagenauer



# MICROBE's ambition



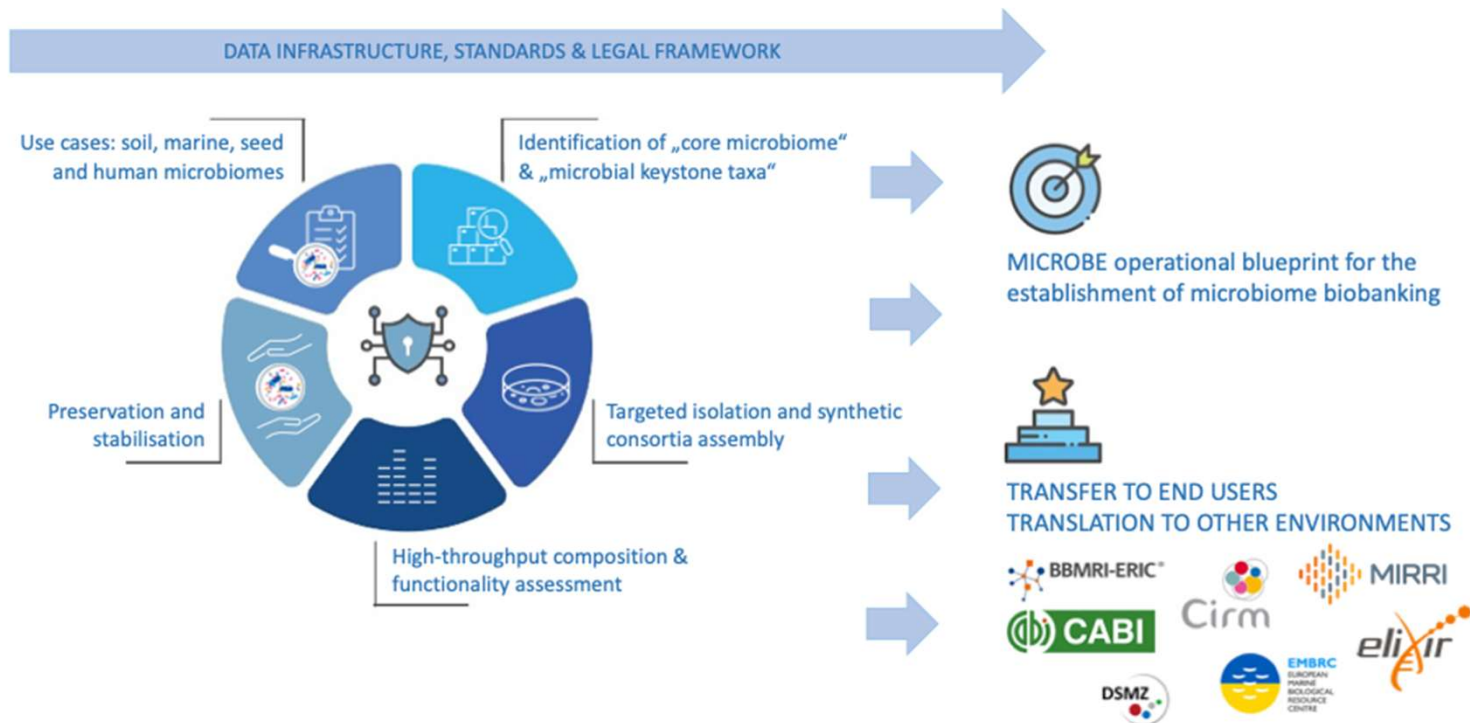
Deliver innovative validated technological approaches that will enable:

- maximal preservation of taxonomic and functional biodiversity in selected microbiome samples
- optimal collection and preservation of microbiome samples for defined subsequent analyses
- targeted isolation of microbiome members from different domains and assembly of synthetic consortia that retain (and even optimize) the functional diversity of original microbiomes

Provide a comprehensive operational blueprint for the establishment of microbiome biobanking infrastructure

- including technological requirements, methodological workflows, data pipelines, standards, legal and ethical guidelines, training plans and business opportunities

# MICROBE approach



# MICROBE approach as applied to soil use case



## Soil sampling in the scope of the German Biodiversity Exploratories initiative

- Regular sampling campaigns since 2007
- Plethora of data available



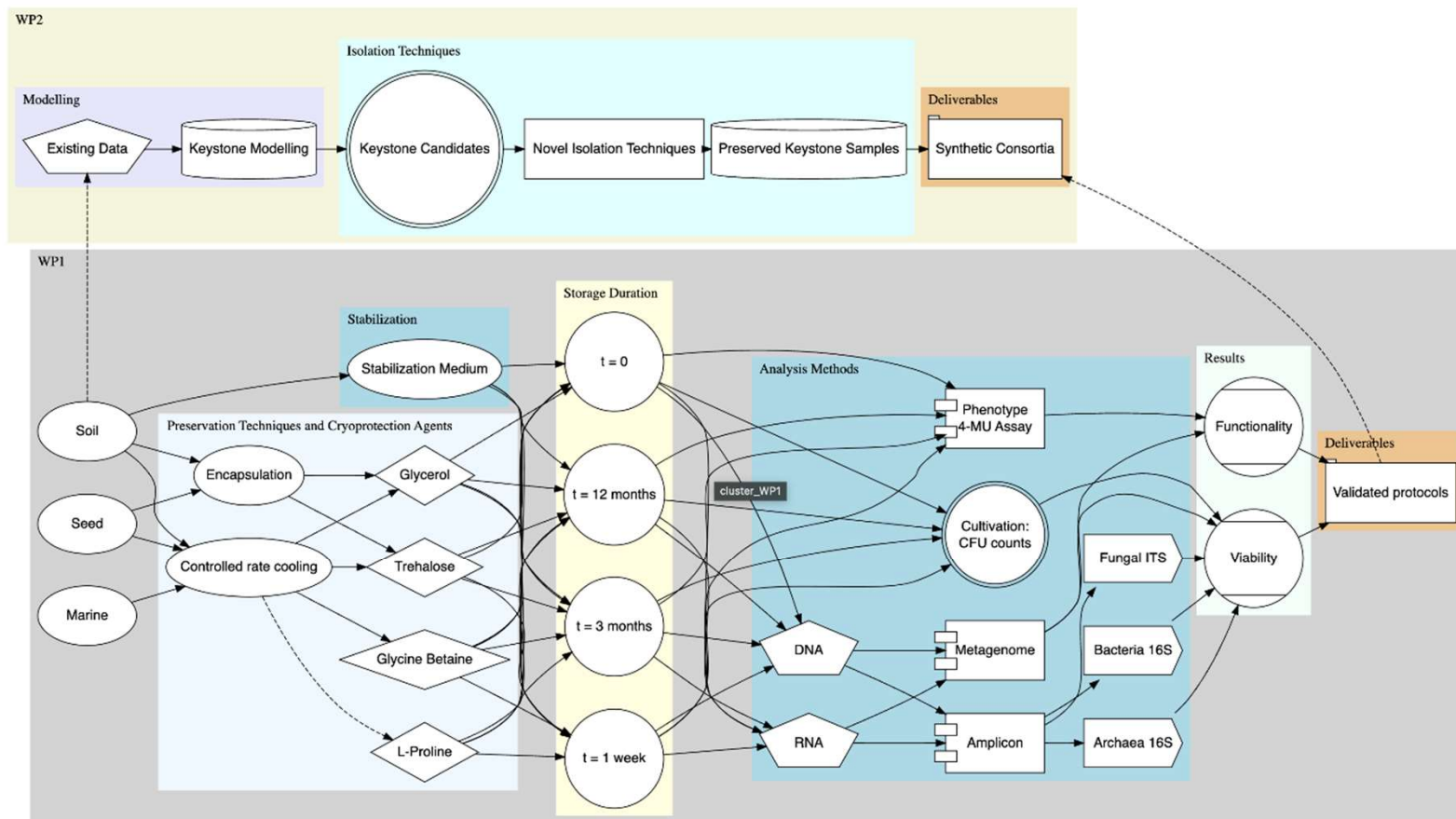
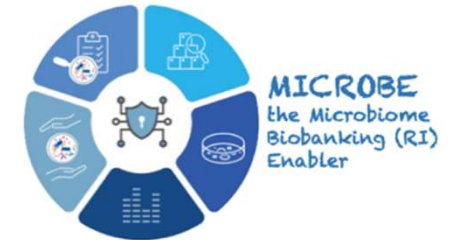
## Same samples distributed across several laboratories for testing

- Common baseline condition
- High-level of method harmonisation
- Numerous preservation/stabilisation methods tested

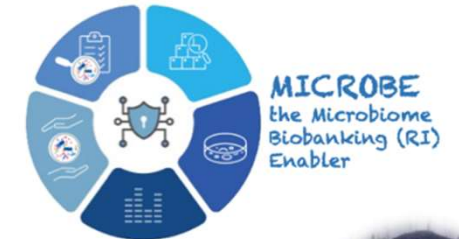
## Experimental scale

- Start: 2 biological samples (soil pool from two different locations)
- Current: >250 sub-samples (preservation methods, time points) & >2000 datasets (different analytical approaches)

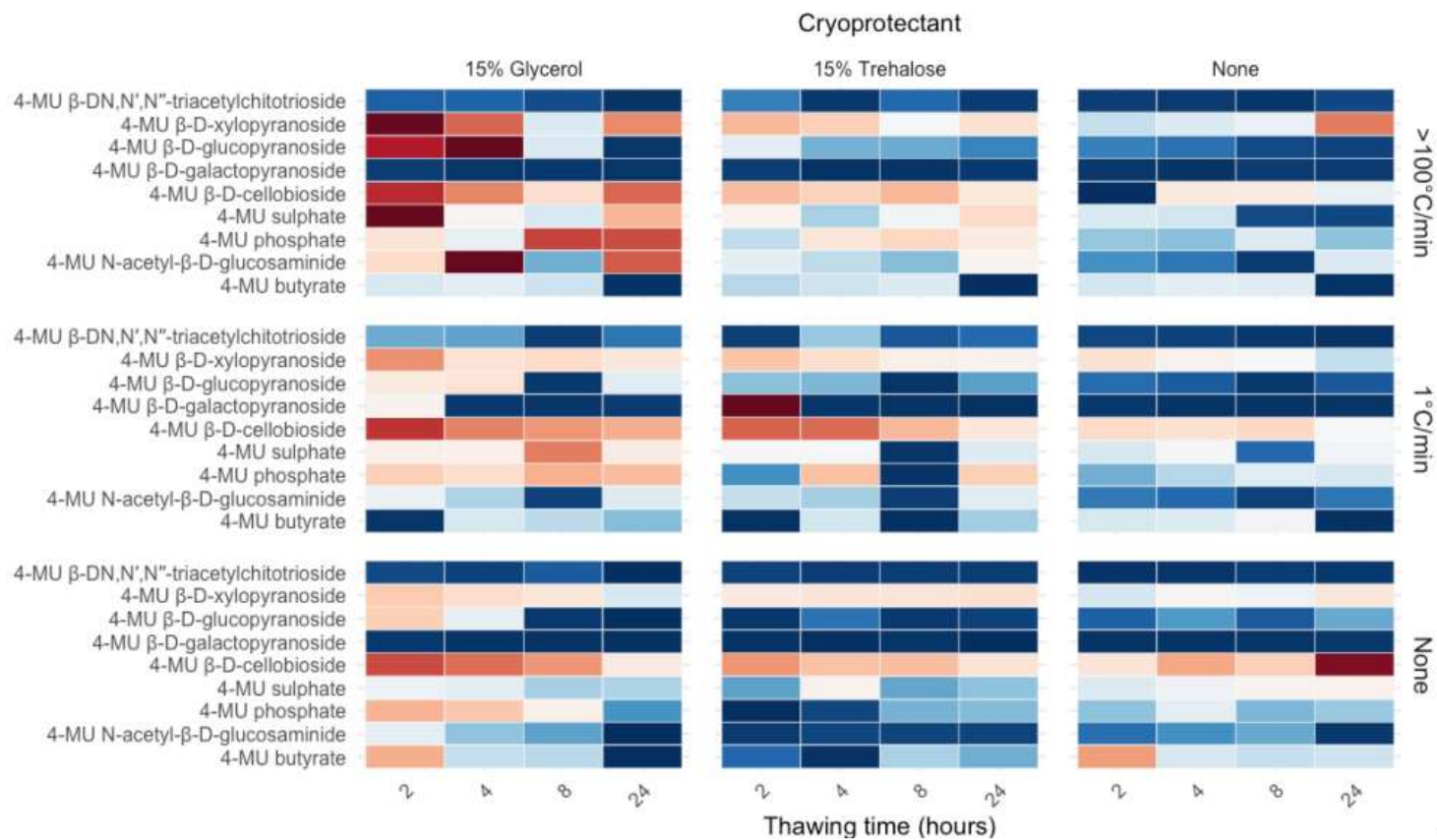
# Soil use case: Process overview



# Soil use case: Result complexity



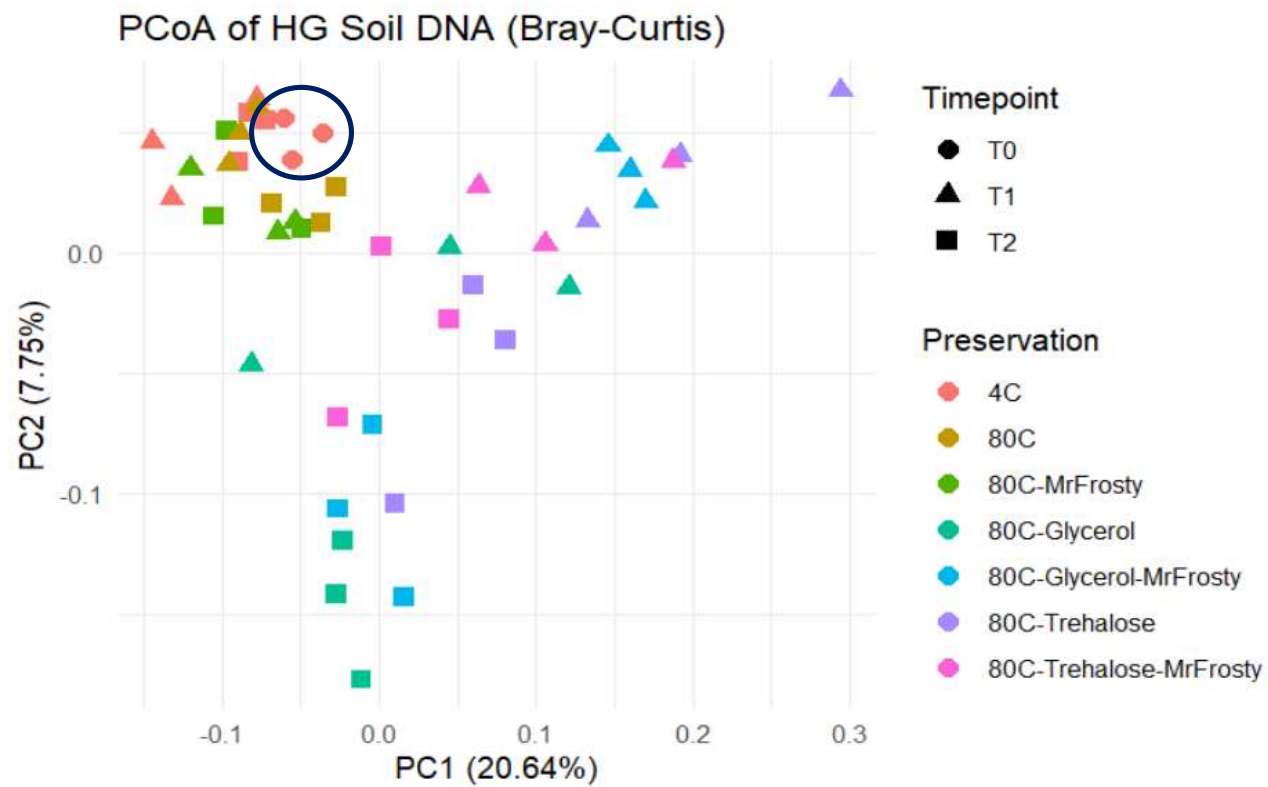
Miguel Bonnin  
CABI



## Soil use case: Result complexity

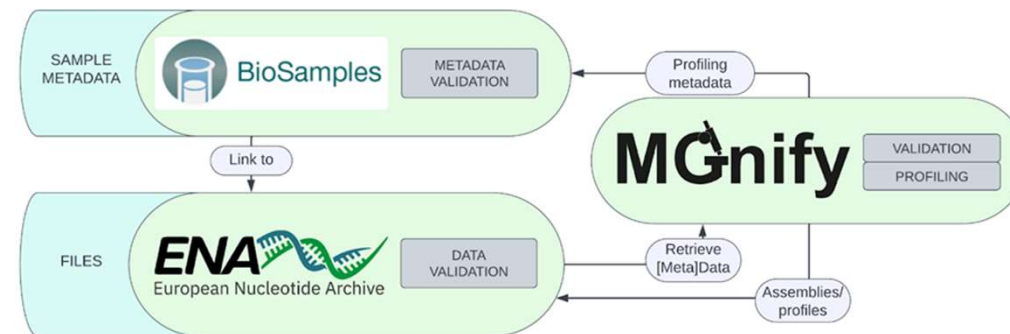
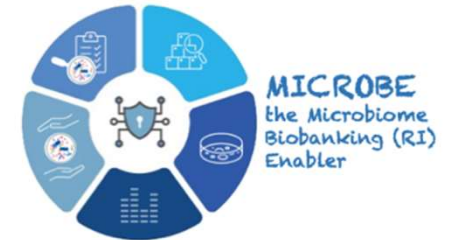


Sara Pipponzi  
AIT





# The importance of comprehensive data infrastructure



# The importance of comprehensive data infrastructure



**BioSamples**

Search results showing 1 to 10 of 2474 samples

Apply filters Clear filters

Showing 1 to 10 of 2474 samples

1 2 3 4 5 ... 248 Next

**organism** 2474

soil metagenome 2224

seed metagenome 152

marine metagenome 96

**environmental medium** 2474

Bulk soil 2224

Seed lot 152

coastal sea water 96

**depth** 2322

missing: sample group 1986

not provided 226

20 (m) 96

0.01 6

**metag\_AEG08\_2023** SAMEA115657809

Updated on: 24-05-2024 14:16

Effective(%) 99.21 Error(%) 0.01 GC(%) 63.21

Library\_Flowcell\_Lane MKD0240001552-1A\_22GYCMLT3\_L6 Q29(%) 96.13 Q30(%) 94.55

Raw data 3606896300 Raw reads 25379322 SRA accession ERS29120818

analysis date 2023-07-01T00:00:00Z biome soil biome 1 soil broad-scale environmen... temperate biome

center HMGU checklist ERF000022 collection date 2023-05-01T00:00:00Z cryoprotectant none

cultivation not provided depth not provided elevation not provided environmental medium Bulk soil

freezing method not provided geographic location (c... Germany geographic location (l... 48.42

geographic location (l... 9.49 geographic location (r... Alb local environmental co... Grassland soil

organism soil metagenome plot\_id AEG08 plot\_id\_BEVS A42131 preservation temperature not provided

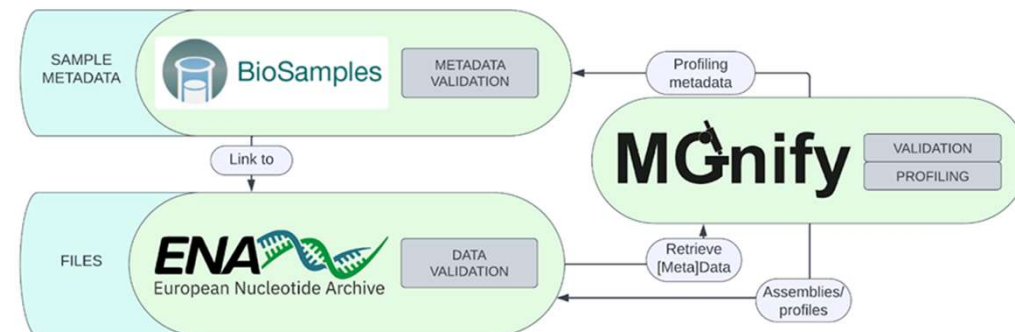
project name MICROBE sample\_id\_byYear AEG08\_23 soil\_type Leguminosae time point T1 year 2023

**Data Hubs**

Browse and search Data Hubs

A [Data Hub](#) is a set of tools that includes workflows for structured data storage and sharing of sequencing data and its analysis interpretations. A manuscript describing the COMPARE Data Hubs is published in Database doi: [10.1093/database/baz136](https://doi.org/10.1093/database/baz136)

microbi		
Name	Title	Description
MICROBE		This datahub hosts the sequencing data for the MICROBE consortium and has been set up to enable partners to view and access data generated within the project.





## Search results

showing 1 to 10 of 2474 samples

10

JSON



Apply filters

Clear filters

« Previous

1

2

3

4

5

...

248

Next »

**organism** 2474

soil metagenome 2224

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Bulk soil 2224

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metag\_AEG08\_2023

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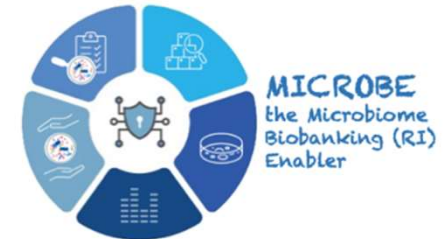
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project name MICROBE sample\_id\_byYear AEG08\_23 soil\_type Leptosol time point T1 year 2023

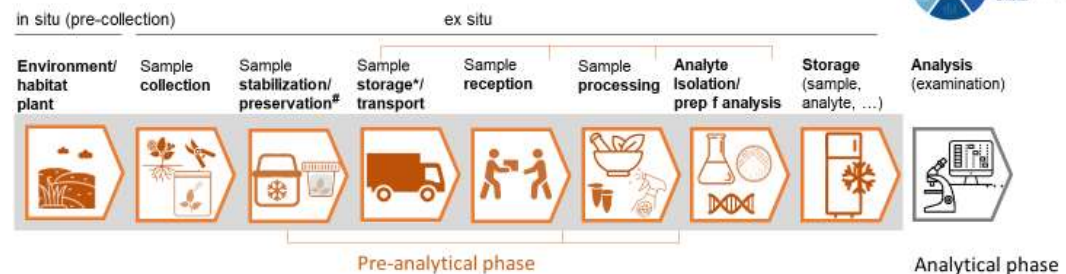
# The importance of the standardisation & metadata



## CEN/TS 17626:2021

Molecular in vitro  
diagnostic  
examinations -  
Specifications for  
pre-examination  
processes for  
human specimen -  
Isolated  
microbiome DNA

### Pre-analytical workflow of plant microbiome study



\* Sample stabilization/preservation: preferentially at sampling area; when not feasible then in the laboratory  
\* Intermediate storage also takes place in the laboratory between certain workflow steps

Icons: © Adobe Stock



- ⇒ List of requirements/recommendations was elaborated in collaboration with experts from EPSO WG Plants and Microbiome
- ⇒ Prioritization survey ongoing



Get in touch...



<https://www.youtube.com/watch?v=sh1XrBLSIYU&t=7s>



<https://www.microbiomesupport.eu/>



THANK YOU!



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