Theme 2. Soil biodiversity in action

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Threats and Drivers of Soil Biodiversity Loss

From: UN-FAO Global Report

Introduction

Theme 2 aims to:

- review the role and the application of soil biodiversity in the field, and
- explore effective and replicable methodologies, techniques, technologies and practices to promote conservation and sustainable use of soil biodiversity.

Goal: upscale sustainable approaches to improve productivity, biodiversity conservation, and guarantee equitable participation in productive landscapes.

Core questions:

1. **What are the main drivers of soil biodiversity loss and what are the consequences? How do losses vary across environments? Can loss of soil biodiversity be reversed?**

- Intensive agricultural practices
- Urbanization
- Industrial resource extraction
- Pollution
- Multiple climate change factors

Physical – soil compaction, soil sealing soil erosion, soil carbon losses

Chemical – soil contamination, toxicity, changes in pH, ions, etc.

Biological – metabolism, bioregulation, bioaccumulation

Core questions:

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Predictable changes:

- Fungal abundance / diversity decrease
- Bacterial dominance increases
- Shifts in arthropod dominance
- Reductions of soil predators

Physical – soil compaction, soil sealing soil erosion, soil carbon losses

Chemical – soil contamination, toxicity, changes in pH, ions, etc.

Biological – metabolism, bioregulation, bioaccumulation

[Briones et al.; Szlavecz et al.]

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Avoid Reduce Reverse

Reversing Soil Biodiversity Loss through Amendments

Soil bacteria communities

Improve soil structural formation

(Bender et al., 2016)

Contribute to plant establishment

(Zink and Allen, 1998)

Organic matter transformation

(Zhao et al., 2019)

Improve biogeochemicals cycles (N, C, P)

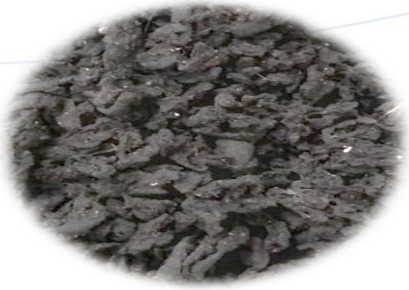
(Bastida et al., 2015)

From: Ortega

From: Kumar

vegetable compost garden waste

vegetable compost from horticulture greenhouse crop residues



stabilized sewage sludge

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soil biodiversity

[Kumar; Rojos et al.; Ortega]

Core questions:

2. How can soil biodiversity support the transformation of agricultural systems toward achieving sustainable intensification?

Soil biodiversity supports the primary soil functions of carbon transformation, nutrient cycling, and soil structure required for plant productivity.

Recommendations:

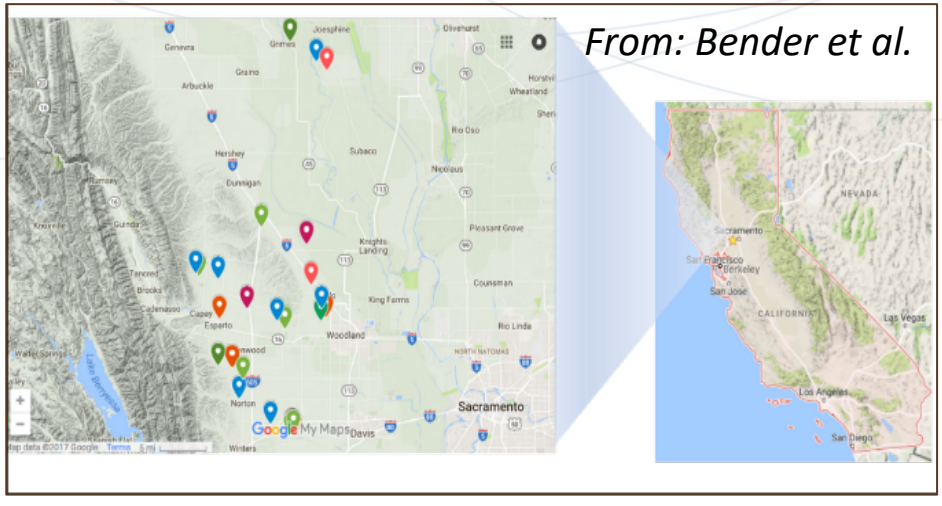
- No or minimum till practices that minimize soil physical disturbance
- Inter- and multi-cropping systems that provide more diverse food production, enhance plant-soil biotic interactions, and prevent soil erosion (compared to fallow)
- Organic amendments that enhance soil carbon, help retain moisture, and are reservoirs for nutrients
- Biological inoculants

[Kulasooriya; Houšková et al.; Rass & Gässler; Francke-Campaña; Ortega; Caucci]

Core questions:

2. **How can soil biodiversity support the transformation of agricultural systems toward achieving sustainable intensification?**

Soil biodiversity can directly support agricultural production and environmental integrity across different level of complexity.



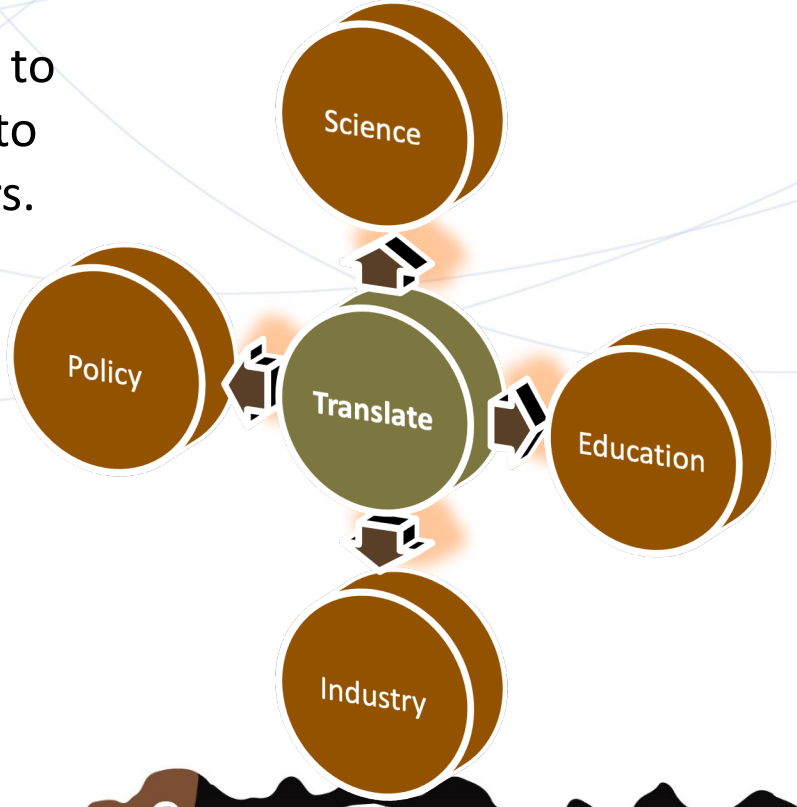
From: Bender et al.

[Bender et al.; Neto; Jouquet]

Core questions:

3. What are the most effective knowledge sharing and capacity building approaches to raise awareness on the better use of soil biodiversity into agricultural practices?

Effective communication strategies are needed to successfully transfer scientific research results to stakeholders, such as policy makers and farmers.



- Participatory learning and action
- Encouraging more traditional practises and innovations
- Engagement and education
- Citizen science initiatives
- Open access sources of information

[Bender et al.; Joshi & Sharma; Rass & Gässler; Motiejūnaitė]

Core questions:

4. **What are the currently successful methodologies, techniques, technologies and practices in place to promote soil biodiversity conservation, sustainable use of its resources and equitable participation in productive landscapes?**

Fungi on Rihter's media
From: Naidonova et al.

Many tools exist:

- 'deep' sequencing, metagenomics
- High-throughput methods
- Gene markers for specific functions
- Enzyme assays and growth medias

[Fornasier et al.; Ortega; Knaebel; Naidonova et al.;]

Core questions:

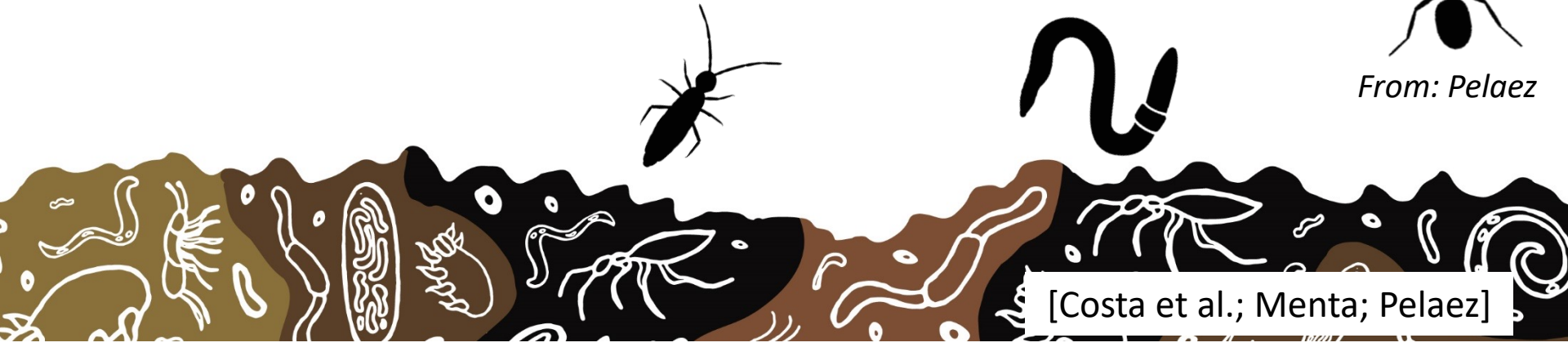
4. **What are the currently successful methodologies, techniques, technologies and practices in place to promote soil biodiversity conservation, sustainable use of its resources and equitable participation in productive landscapes?**

The use of bioindicator species:

From: Costa et al.

- Nematodes Maturity Index
- QBS-AR index for soil arthropods
- Keystone species and ecosystem engineers

From: Pelaez



[Costa et al.; Menta; Pelaez]

Core questions:

4. **What are the currently successful methodologies, techniques, technologies and practices in place to promote soil biodiversity conservation, sustainable use of its resources and equitable participation in productive landscapes? How can we upscale biodiversity-based solutions and other sustainable approaches?**

Soil biodiversity can accelerate or facilitate soil restoration.

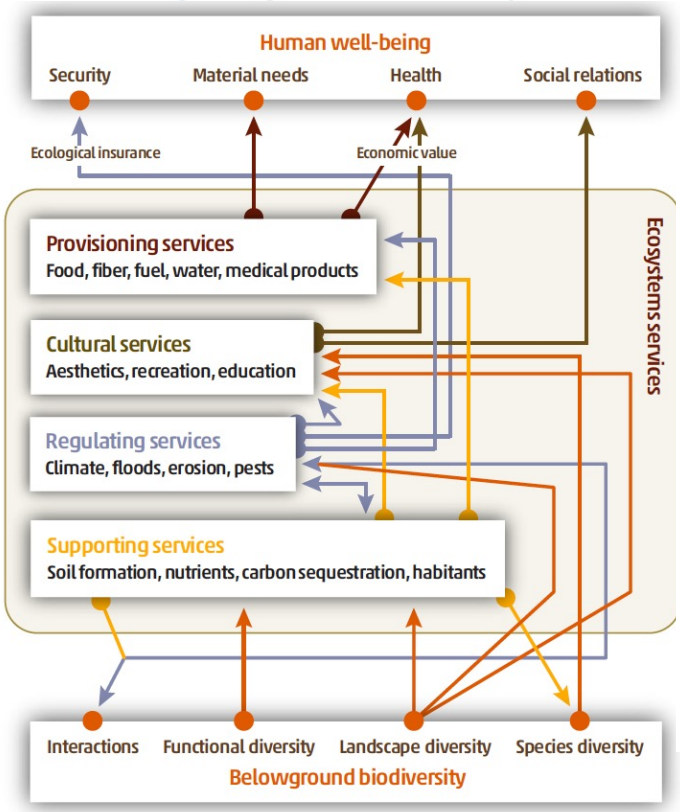
- Organic amendments that enhance soil carbon, help retain moisture, and are reservoirs for nutrients (e.g. biochar)
- Biological inoculants and bioaugmentation (biocrusts, AMF)
- Keystone species (e.g. earthworms)

Example of biochar
From: Taco & Zuñinga-Dávila

[Neto et al.; Taco & Dávila; Migliore; Barger; Vahter; Castro et al.]

Core questions:

5. How can soil biodiversity support the One Health approach?



From: UN-FAO Global Report

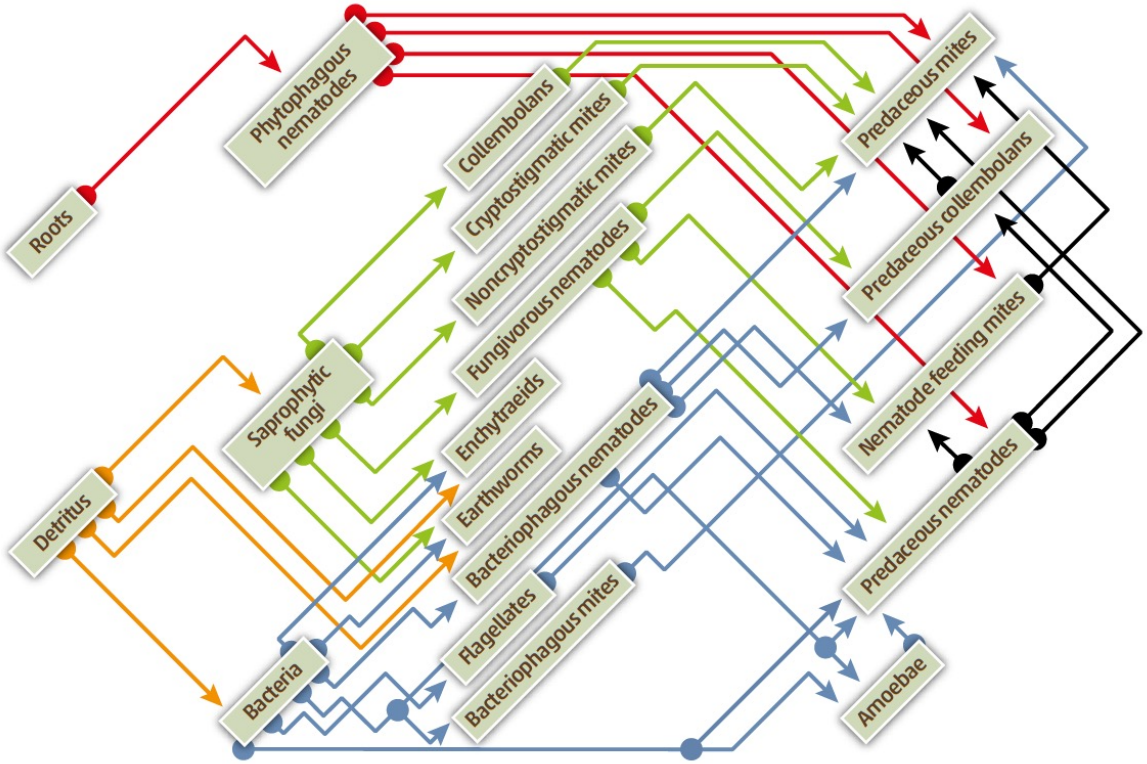
Figure 3.2.1 | Relationship between soil biodiversity and ecosystem services

One Health recognizes that the health of people is closely connected to our shared environment.

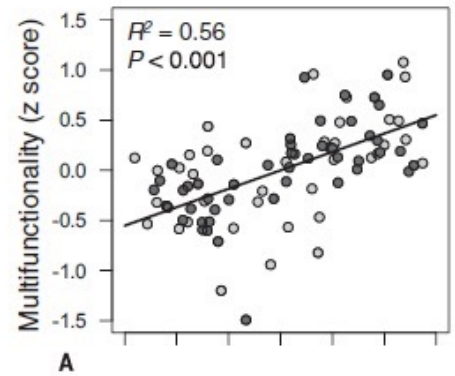
[Jouquet et al.; Motiejūnaitė; Briones et al.]

Core questions:

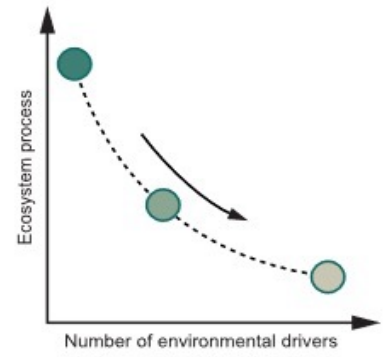
6. How do we best address the complexity of soil systems?



From: UN-FAO Global Report



Wagg et al. (2014)



Rillig et al. (2019)

[Briones et al.; Caucci; Castro]

Thank you for your attention!

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