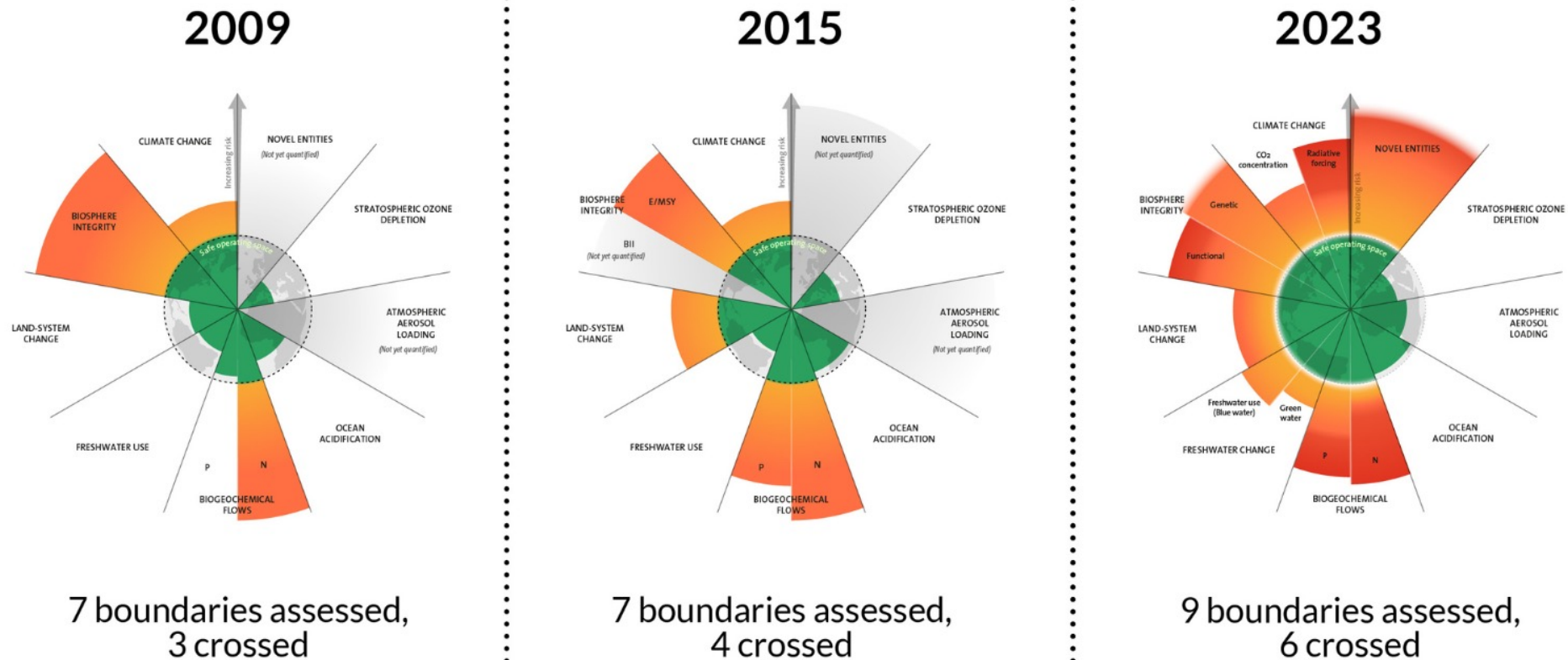


# What is the global change driver that worries you the most?



<https://www.stockholmresilience.org/research/planetary-boundaries.html>

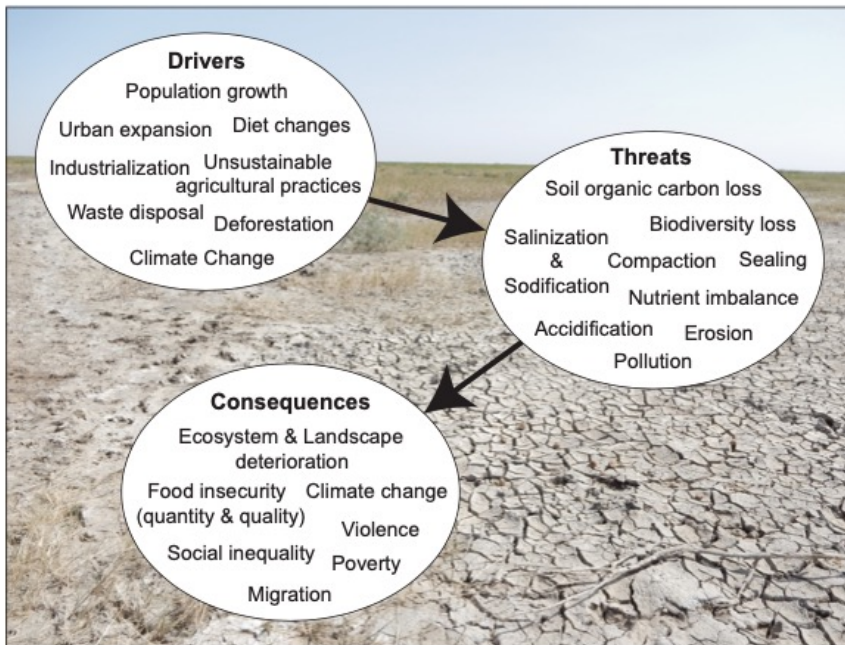
# Are the planetary boundaries really defining a 'safe operation space' for humanity?

1. It is a key process for the stability of the Earth system
2. Interfering with the process threatens to cause 'unacceptable' environmental changes
3. Interference is caused by human activities
4. Displays 'tipping point' behaviour when forced beyond a critical level
5. Relevant on a local and global scale
6. It is strongly interrelated with other planetary systems



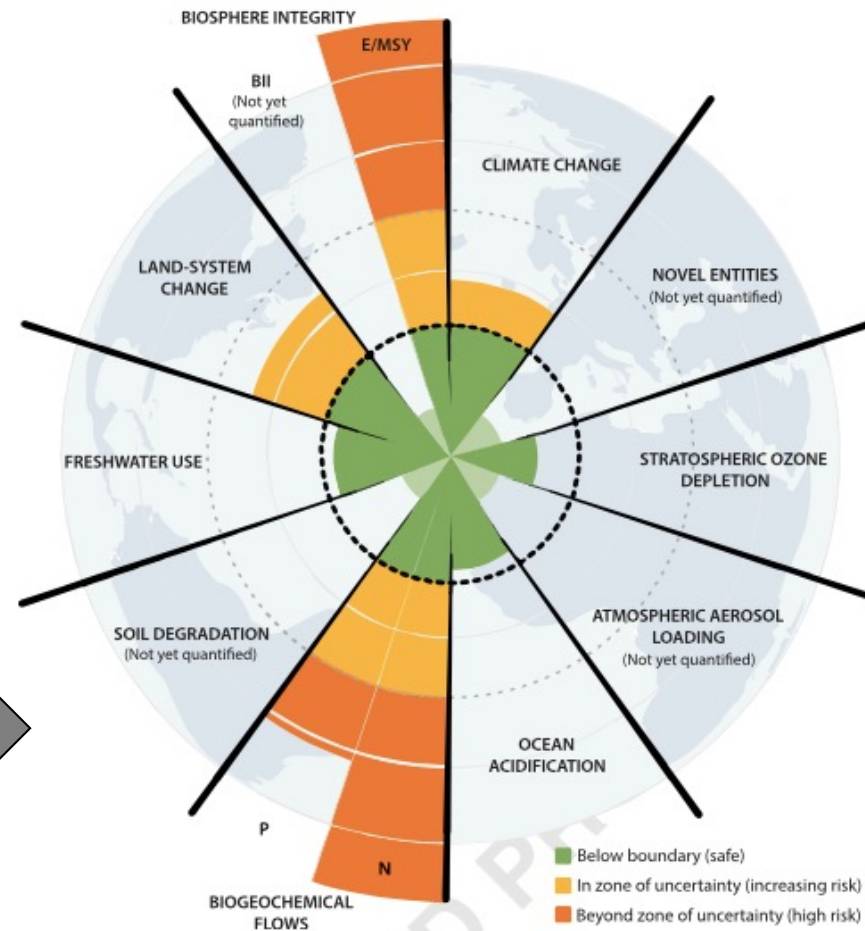
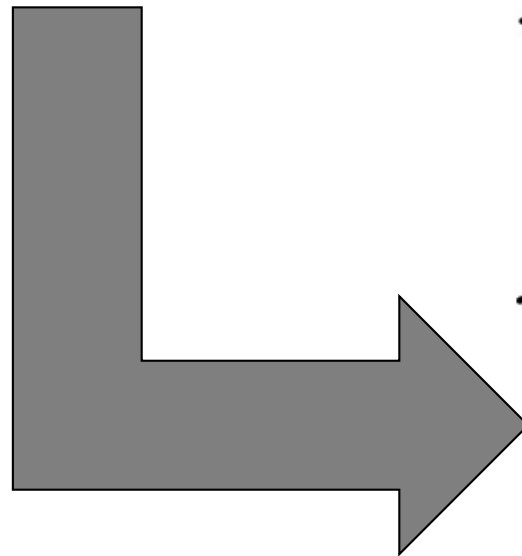
**Are we  
missing/ignoring  
other planetary  
boundaries?**

# Soil degradation fulfils all criteria



1. It is a key process for the stability of the Earth system (soil is fundamental for the provisioning of ecosystem services, to achieve the UN's Sustainable Developmental Goals)
2. Threatens to cause 'unacceptable' environmental changes (e.g., erosion, contamination, loss of organic C)
3. Is caused by human activities (e.g. agriculture, deforestation, urbanization)
4. Displays 'tipping point' behaviour when forced beyond a critical level (soil restoration is so slow that soil is considered as a non-renewable resource)
5. Relevant on local and global scale (already affects 3.2 billion people and by 2050, 90% of the soils will be degraded)
6. It is strongly interrelated with other planetary systems (e.g., biodiversity loss, changes in the N and P cycles, climate change)

# Soil degradation as the 10<sup>th</sup> planetary boundary



Kraamwinkel et al 2021

**Fig. 2 Proposed new planetary boundaries framework.** Updated version of the planetary boundaries framework portraying the current nine Earth system processes along with soil degradation as the 10th Earth system process. The small circle (bold dotted line) represents the planetary boundaries. The large circle (regular dotted line) portrays the thresholds. Adapted from the original image of the planetary boundaries framework constructed by J. Lokrantz/Azote based on Steffen et al.<sup>2</sup>. Licensed under CC-BY.





Read, D. The ties that bind. *Nature* **388**, 517–518 (1997).

# Soil ecology

Microbiology and Ecosystems  
Engineering

Teresa Dias – [mtdias@ciencias.ulisboa.pt](mailto:mtdias@ciencias.ulisboa.pt)



# What do all terrestrial ecosystems have in common?



# Soil ecosystem services

Are the benefits that people receive from soil, including clean air and water, food production, and regulating climate. Soil is the link between air, water, rocks, and organisms

EU Academy





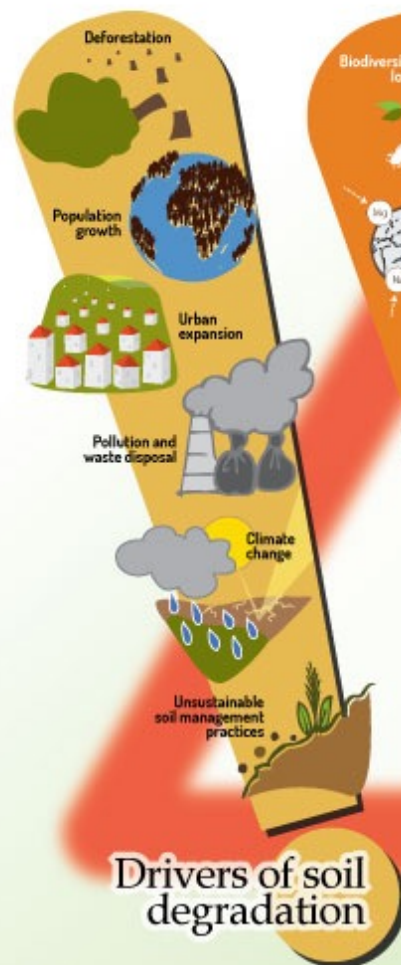
**“Who” is  
responsible for the  
soil ecosystem  
services?**



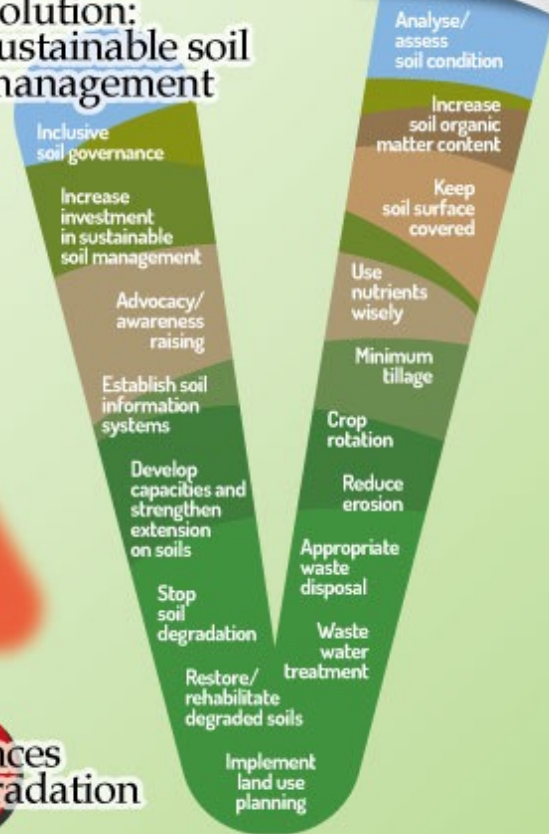


# our Soils under threat

2015  
International  
Year of Soils  
[fa.org/soils-2015](http://fa.org/soils-2015)  
#IYS2015



## Solution: sustainable soil management



Food and Agriculture  
Organization of the  
United Nations



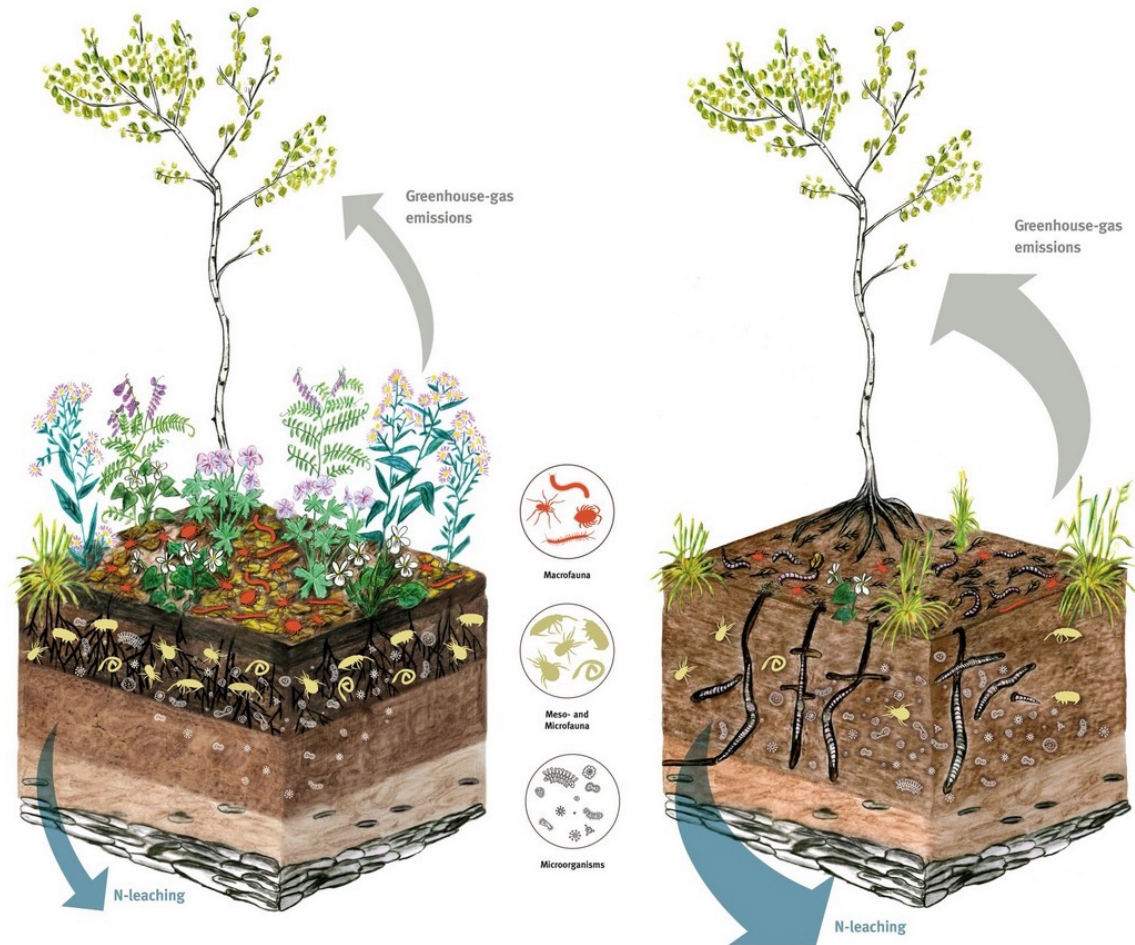
with the support of

Types of soil  
degradation

Consequences  
of soil degradation

# Consequences of soil degradation:

↓ **soil health**



# Deforestation and land use changes



- **Carbon storage**
- **Water** (quality and quantity)
- **Regional and global climate regulation**
- **Diseases**
- **Biodiversity**



# How deforestation and land use changes impact soil ecosystem services?

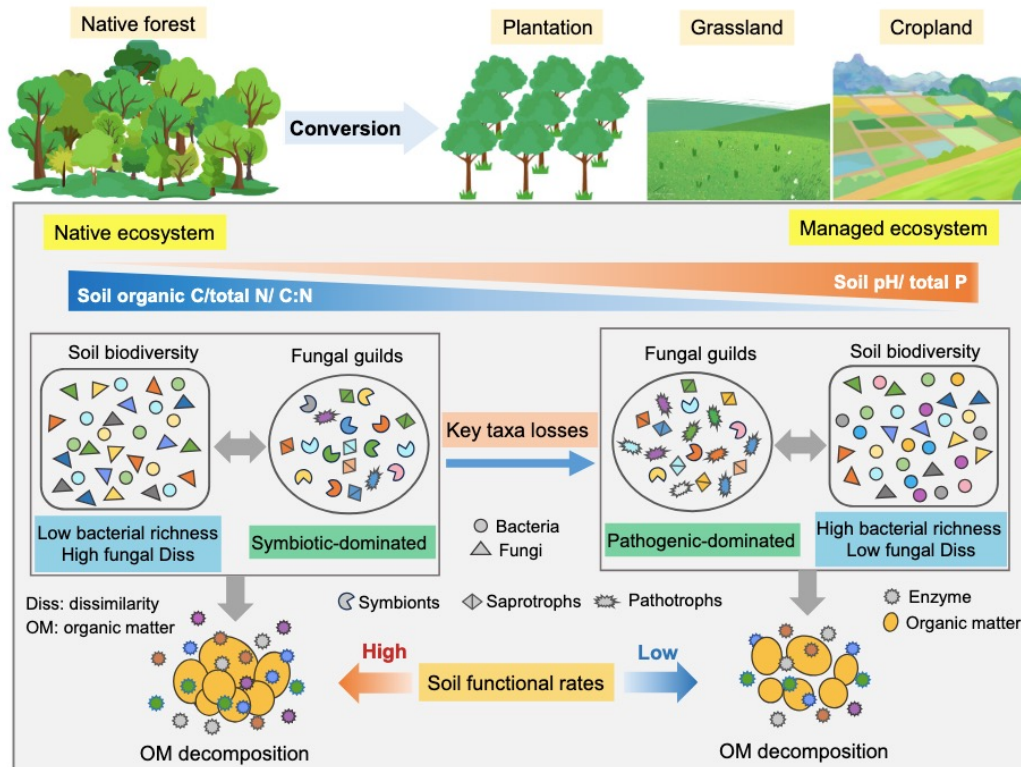


Fig. 6. Conceptual model illustrating the impacts of native forest conversion to other land use types on soil properties, microbial community, and functions.

- **Global** dataset including 696 paired-site observations to investigate how native forest conversion to other land uses affects soil properties, biodiversity, and functions associated with multiple ecosystem services.
- Responses of the microbial community to deforestation were predominantly regulated by **changes in soil pH and total phosphorus**.
- The conversion of native forests to plantations, grasslands and croplands resulted in **higher bacterial diversity and more homogeneous fungal communities dominated by pathogens and with a lower abundance of symbionts**.
- Such conversions also resulted in **significant reductions** in carbon storage, nutrient cycling, and soil functional rates related to organic matter decomposition.